THE FAILURE OF THE AMERICAN AERONAUTICAL PRODUCTION AND PROCUREMENT EFFORT DURING THE FIRST WORLD WAR

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by

Charles F. O'Connell, Jr., B.A.

The Ohio State University
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Approved by

[Signature]
Adviser
Department of History
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td></td>
<td>pp. 1-13</td>
</tr>
<tr>
<td>Chapter I</td>
<td>Organizing for Failure</td>
<td>pp. 14-38</td>
</tr>
<tr>
<td>Chapter II</td>
<td>Roots of the Program</td>
<td>pp. 39-55</td>
</tr>
<tr>
<td>Chapter III</td>
<td>Numbers and Types: The Program Takes Shape</td>
<td>pp. 56-74</td>
</tr>
<tr>
<td>Chapter IV</td>
<td>The Failure of the Aeronautical Effort</td>
<td>pp. 75-95</td>
</tr>
<tr>
<td>Chapter V</td>
<td>Conclusion</td>
<td>pp. 96-110</td>
</tr>
<tr>
<td>Bibliography</td>
<td></td>
<td>pp. 111-115</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Appropriations for Aviation, Fiscal Year 1913</th>
<th>p. 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2</td>
<td>Appropriations for Aviation Fiscal Year 1915</td>
<td>p. 9</td>
</tr>
<tr>
<td>Table 3</td>
<td>Aviation Plant Allocation, 1917</td>
<td>p. 32</td>
</tr>
<tr>
<td>Table 4</td>
<td>Aircraft and Engine Types Selected for Production, August, 1917</td>
<td>p. 63</td>
</tr>
<tr>
<td>Table 5</td>
<td>DH-4 Production Programs</td>
<td>p. 64</td>
</tr>
<tr>
<td>Table 6</td>
<td>Bristol Fighter Programs</td>
<td>p. 65</td>
</tr>
<tr>
<td>Table 7</td>
<td>Airframe and Engine Contractors</td>
<td>p. 66</td>
</tr>
<tr>
<td>Table 8</td>
<td>American Orders for French Aircraft and Engines</td>
<td>p. 79</td>
</tr>
<tr>
<td>Table 9</td>
<td>American Aeronautical Production During the First World War</td>
<td>p. 91</td>
</tr>
</tbody>
</table>
INTRODUCTION

It has become axiomatic that the United States has traditionally found itself woefully unprepared to fight the wars it has entered. While this idea need not be accepted as dogma, especially in regard to the wars of the last thirty years, the statement is essentially true for most of our conflicts and is especially true of our involvement in the First World War. In 1917, American industry was willing but not able, in the short time it would have, to make the contribution to the war effort expected of it by American planners. In no field of our endeavor was this more obvious or more costly than in the aircraft production program. The purpose of this thesis is to examine America's First World War aeronautical effort in an attempt to determine why it was unable to achieve the goals set for it in the early days of the war.

There were four fundamental problems which most seriously delayed the production of aircraft in quantity and contributed significantly to the failure of the aviation procurement program. The first and most important was the pre-war governmental neglect of the fledgling aircraft industry. The anemic condition of this sector led to the decision to place major elements of the aircraft program in the hands of
the more developed but equally incapable automotive industry. Enthusiastic but inexperienced, the auto makers tried to produce aircraft as if they were cars, unaware of the tremendous complexity of the production and inspection techniques necessary to insure the safety and reliability of the aircraft. The results were disappointing at best. Second, the production plans formulated in the hectic days of mid-1917 set goals which were beyond the existing capabilities of American industry. These plans doomed the program to failure before it was even officially launched. The over-optimistic goals were the result of the paucity of information and understanding of the effort needed to create an industry and to produce planes in an economy already strained to some extent by other war contracts. They also reflected how little policy makers knew about the conditions and demands of aircraft production. Third, the program was delayed by unnecessary indecision on the numbers and types of aircraft that were to be selected for production. Finally, production decisions were made that created more unnecessary disarray and retarded work. The most important of these was the effort to install the United States Standardized Aircraft Engine, more commonly known as the "Liberty" engine, into airframes that were not designed to accommodate an engine of its power. The Liberty decision again demonstrates the extent to which decision makers were ignorant of the intricacies of aircraft design and construction.
These four problems will form the basis for discussion in this study.

* * * *

The question of aviation procurement in World War I has been largely ignored by historians for the last forty years. Irving B. Holley, Jr., in his Ideas and Weapons: Exploitation of the Aerial Weapon by the United States During World War I (1953) discusses the shortcomings of American aviation as the result of the failure to adopt doctrines for the use of a new weapons system. He blames the failure of the military procurement and production program on indecision about how the aircraft were to be used: "The problem of aircraft development was tremendously complicated by the prevailing uncertainty regarding tactical objectives; ... The procurement of superior aircraft implied two prior assumptions: first, a knowledge of the mission of the new weapon; and second, a knowledge of the types of aircraft necessary to accomplish this mission."\(^1\) While this is true, it is obvious that Holley believes that the United States could have produced aircraft in quantity if only the planes' mission had been clear. It is possible that this hypothesis neglects the industrial potential of those sectors of the economy that were to produce the planes themselves. It appears that, given the industrial situation of 1917, the United States would have been extremely hard-pressed to produce military aircraft in quantity even if it had posses-
sed a clear-cut doctrine for their use, which it certainly did not. Doctrinal insufficiency does not provide a complete explanation for the failure of the program. Serious production bottlenecks, the result of a long series of poorly made decisions, made doctrinal indecision a moot point. The most imaginative doctrines were useless without aircraft.

Other historians, most notably Robert D. Cuff and Paul A. C. Koistenen, have examined the World War I aircraft program and especially the bureaucracy established to formulate and control it as examples of the early development of the military-industrial complex. Once again, these studies concentrate on only one aspect of a more complicated problem. In fairness, neither historian studied the program or its inadequacies in detail. They do, however, touch on issues which may help to explain the dismal performance of the industries involved with the program. Many contemporaries questioned the suitability of several of the men chosen to run the production effort. This question will be discussed more thoroughly in a later chapter.

The fact that modern historians have largely ignored the study of the aircraft program during World War I is especially surprising when one considers the volume of work produced by contemporaries. An outpouring of emotional reports, memoirs, and monographs appeared in the decade after the war. This flood of often contradictory and emotionally-biased information encouraged the popular perception that the
aircraft program was an abject failure. Parties on all sides of the issue made efforts to insure that their side of the debate was made public.

In the Twenties, the debate was fed by differing perceptions of the program. Critics claimed that the aviation plan was a mistake, that the hundreds of millions of dollars spent on it could have been better spent elsewhere. They claimed to have found evidence of corruption and criminal activity in all phases of the program. Many of their arguments reflect the views of a large segment of the population, which had accepted governmental assurances that America would fill the sky with aircraft. Few people, in the government or elsewhere, were aware that the rosy expectations and predictions in no way reflected the reality of the situation. Without recognizing the difficulties industry faced, it was easy to blame the failure on corruption. Without personal malfeasance, there was no reason why American industry could not succeed.

Those who wrote in support of the program did so for two reasons. The first was clearly self-interest. Those who ran the program had to find some evidence of success to justify their own actions and perhaps to avoid prosecution. Others professed to have recognized the impossibility of reaching program goals and stressed what in fact was accomplished by industry. The latter group made a valid point. The critics, however, reached a much broader audience and
their views gained credence in the Twenties. Even today, writers tend to stress the failures without recognizing the successes of the program.

By 1918, many in Congress and elsewhere recognized that the program was in very serious trouble. Their calls for answers led to a series of investigations, sanctioned by Congress, which made detailed inquiries into the operations of the Washington bureaucracy. The records of these investigations formed a mass of information that provided much of the primary data upon which this study is based. Detailed and relatively unbiased, the reports of Senator Charles S. Thomas, Chief Justice Charles Evans Hughes, and the Graham Committee formed the standard against which the work of others could be compared. The end of the war brought a series of reports from the military and civilian bureaucracy that also proved invaluable.\(^3\)

* * * * *

The Army's interest in aviation can be traced to the Civil War when it first used balloons for military purposes. It was not until December 23, 1917, however, four years after Orville Wright had made his pioneering flight, that the Army sought bids on its first heavier-than-air flying machine. This aircraft was delivered in August, 1908 and accepted into service one year later. It had taken six years for the United States to put its first military aircraft into service. Indeed, until 1911, three years before the start of
the European war, the Army had but one plane and one pilot. It was fortunate to have even this pitiful force. It took the direct intervention of President Theodore Roosevelt and Secretary of War William H. Taft to insure that the Board of Ordnance and Fortification issued minimum performance standards for military aircraft as requested by the Wright brothers. The Signal Corps, then in charge of aeronautical development, established on August 1, 1907, the Aeronautical Division, which had "charge of all matters pertaining to military ballooning, air machines, and all kindred subjects."
The Aeronautical Division of the Signal Corps supervised the development of military aviation in the years before the war and had charge of the production program during the war.

Throughout the first fifteen years of the twentieth century the development of Army aviation was significantly retarded by an almost complete lack of funds and a pervading sense of bureaucratic disinterest that prevented effective lobbying for more money. Military men interested in furthering the development of aeronautics, a small but increasingly vocal minority, never had the funds to expand research, development or instruction beyond levels which kept aeronautics a barely functioning section within the Signal Corps. The few trained pilots flew a small number of planes, often rebuilt after accidents. The flying program was also hampered by a lack of skilled mechanics and other ground support personnel.
By about 1911, however, the Aviation Section began a period of slow if unspectacular growth. In March, 1911, Congress appropriated $125,000 for Army aeronautics, $25,000 of which was available immediately. This money was used to order five new planes, three from the Wright brothers and two from Glenn H. Curtiss. The continuing shortage of funds restricted the development not only of the airplane but also of the aircraft industry. Without government contracts there was little impetus for growth, since civilian demand was virtually non-existent. The depressed state of the aircraft industry was to have a profound effect on the aircraft program's problems.

The next four years witnessed the slow growth of a military air force. The lack of funds continued to limit the purchase of new aircraft, the training of pilots, and the purchase of land for flying fields. As a result of the shortage of facilities, technological advances occurred infrequently and more often by chance than by any concerted scientific effort. Those fields that were established, in Maryland, Georgia, Texas, and California were the site of what little aeronautical progress the Army made. The pilots who passed through the training facilities located at these fields were to form the nucleus around which the Army built the leadership cadres of its air forces in both wars.

The anemic state of aviation is most readily seen when one compares appropriations for aviation for the fiscal
year 1913, the last year of Europe’s peacetime budgets:

**TABLE 1**

**APPROPRIATIONS FOR AVIATION, FISCAL YEAR 1913**

<table>
<thead>
<tr>
<th>Country</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>$7,400,000</td>
</tr>
<tr>
<td>Germany</td>
<td>5,000,000</td>
</tr>
<tr>
<td>Russia</td>
<td>5,000,000</td>
</tr>
<tr>
<td>Great Britain</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Italy</td>
<td>2,100,000</td>
</tr>
<tr>
<td>Mexico</td>
<td>400,000</td>
</tr>
<tr>
<td>United States</td>
<td>125,000</td>
</tr>
</tbody>
</table>

The situation worsened after the outbreak of the war. By 1915, the United States had fallen even further behind European aviation in tactical and technical developments and expenditures:

**TABLE 2**

**APPROPRIATIONS FOR AVIATION, FISCAL YEAR 1915**

<table>
<thead>
<tr>
<th>Country</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>$45,000,000</td>
</tr>
<tr>
<td>Russia</td>
<td>22,500,000</td>
</tr>
<tr>
<td>France</td>
<td>12,800,000</td>
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<tr>
<td>Austria</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Great Britain</td>
<td>1,080,000</td>
</tr>
<tr>
<td>Italy</td>
<td>800,000</td>
</tr>
<tr>
<td>United States</td>
<td>300,000</td>
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Safe from attack behind its ocean barriers and pursuing a policy of official neutrality, America escaped the intense spirit of international competition which pervaded the
European military establishments in the years before World War I. American aviation was at least one generation behind developments in Europe.

Despite its unwillingness to appropriate funds for military aeronautics, Congress was prepared to establish a wide variety of committees and boards to investigate aviation's potential. An act of July, 1914 gave official sanction to the Aviation Section of the Signal Corps, a mere seven years after it had been organized by the War Department. The act created a section consisting of 60 officers and 260 enlisted men and provided for special pay and ratings for aviators. The most important aspect of the legislation was the permanence it gave Army aviation. Manufacturers, more sure of a steady if limited market, were more willing to accept the financial risks of building aircraft for military purposes. Unfortunately, this was too late to be of any help to an industry that was to face the demands of a war only two years hence.

As aviation began to assume an increasingly more important role in the European war, the United States found itself falling farther and farther behind in technical expertise. The Punitive Expedition to Mexico, seen by proponents of aviation as a chance to establish and refine the doctrines of air liaison and support, in fact showed how woefully inadequate military aviation was. The First Aero Squadron was sent to the Mexican border in March, 1916, approximately one
year before America's declaration of war on Germany. Operations in Mexico did little more than demoralize the Army's fliers. The squadron's aircraft were unable to cope with the geographic and climatic conditions they faced in Mexico. Especially vexing was the inability of the aircraft to cross the 15,000 foot mountain ranges that blocked the path of the American advance. Unable to perform the only mission the planes were suited for - observation - the two aircraft that were still in service on April 20, 1916 were returned to the United States to be condemned and destroyed.

The status of aviation in the United States when war was declared was extremely critical. The organization charged with developing the weapon had neither the funds nor the expertise to do the job adequately. The Army had virtually no material, personnel, or experience in designing, producing or using modern combat aircraft. Of the 142 aircraft delivered to the Signal Corps before 1917, most had been lost in operations or declared obsolete and destroyed. There was no American-made plane suitable for use in combat. No individual or group could accurately predict the aeronautical requirements of the war, especially since the European combatants were understandably reluctant to divulge their secrets to a supposedly neutral third party. Those in charge of the aircraft program could only guess at the types of engines, airframes, and armament components that would be needed at the front.
More importantly, adequate manufacturing facilities for the large-scale production of aircraft did not exist in this country. The companies that did exist produced relatively simple planes in small numbers because of a lack of either commercial or military demand or effective governmental support. Less than a dozen professional aircraft designers worked in the United States in 1917, and not one had ever designed a complete fighting machine, at least of the type then in use in Europe.4

This was the state of affairs that faced government planners on the eve of America's entry into the war. Unfortunately, almost no one in a position of authority recognized the gravity of the situation. The production programs that emanated from Washington appear to have been created in a near vacuum without any serious consideration of the state of American industry and aeronautical technology at the time.

That America was able to produce several thousand planes and perhaps the finest aeronautical engine of its day in the face of these difficulties is an accomplishment that was denigrated at the time and is all but forgotten now. This thesis will examine the roots and results of the military aviation production and procurement effort in an attempt to explain the reasons for its costly mistakes and small successes.
NOTES


CHAPTER I

Organizing For Failure

America's declaration of war on Germany on April 6, 1917 marked the beginning of this nation's nineteen month involvement in the greatest, most destructive war mankind had experienced to that time. The European combatants, exhausted after three years of bloody, inconclusive fighting, recognized that the arrival of the Americans in force would be decisive by eventually giving material superiority to the Allies. The German offensive in the spring of 1918 was an attempt to forestall the effects of America's entry into the war by forcing the Allies to seek peace before American industrial and manpower reserves could be brought to bear. In 1917, America's most immediate task was to mobilize the human and industrial wherewithal that could win the war. To meet this task, planners in Washington began to formulate the programs that would harness this nation's vast patriotic energy and focus it on production for war. These plans affected virtually all phases of American life to an extent that would have been thought impossible a decade earlier.

Decision makers were forced to rely on a shotgun approach to do all that had to be done in a very short time. Denied any effective pre-war planning by the strong sentiment
favoring neutrality that pervaded American society, planners in the War Department and elsewhere had to make decisions involving hundreds of millions of dollars and thousands of workers almost overnight. Surprisingly, many of these decisions proved to be wise. American industry achieved an enviable record by the end of the war. Unfortunately, some sectors performed less successfully than others.

When the United States entered the war, the highest expectations were reserved for the aircraft production program. Aerial warfare had become an important part of military tactics on the Western Front, and air combat had captured the imagination of many people. Above the stalemate trenches, it seemed to be the system that could break the deadlock. Some strategists believed that if control of the air could be gained, final victory would follow. If America provided the planes, it would make a substantial contribution to the final victory.¹

Unfortunately, there was no phase of the immense undertaking in which the United States was so utterly unprepared. Pre-war governmental neglect of the potential of the airplane had stunted the growth of the few existing aircraft producers. There was no large industry in the United States that could turn readily to the production of airplanes. Even if such an industry had existed it would have been almost worthless in the early days of the war, since modern aircraft of the type used in Europe in 1917 had not been built
in the United States. During the three years of war, the airplane had gone through a generation of technical progress. The United States saw this progress as a distant observer. It knew little of what was necessary to build the contemplated industry.\(^2\)

Since few could conceive of the difficulties involved in creating an industry almost from nothing, the public accepted without question the rosy predictions of success that were made in Washington. People assumed that nothing could be easier than "filling the sky with aircraft." The result of this misplaced optimism was that when the difficulties became obvious, the public felt that it had been willfully misled. This was not, in fact, the case. There were instances where statements were made that were over-optimistic and simplified the problems to be faced and overcome, but they were made sincerely and reflected the ignorance of what had to be done to inaugurate quantity production.\(^3\)

Production planners faced some vexing problems from the outset. Of major concern were conditions in Washington, D. C. Assessing the situation in the field of aircraft procurement, Secretary of War Newton D. Baker admitted that "there was perfect confusion, and everybody was bringing suggestions." This situation continued for almost two months. Various individuals and bodies submitted an endless and bewildering assortment of plans, each differing in significant details. Those bodies that were to make the final decisions
regarding procurement were unable, due to inexperience more than any other reason, to quickly assess the potential of these various suggestions and formulate a program. The impetus for the final decision came from French Premier Alexandre Ribot, whose cable of May 24, 1917 suggested the possible size of the projected American aircraft program. The Ribot cable, which will be discussed in more detail in succeeding pages, provided a concrete proposal the planners could consider.

The inexperience of key members of the Wilson Administration, especially Secretary of War Baker, also created problems. Baker came to Washington after serving as mayor of Cleveland, Ohio. Testifying before a Congressional committee, he acknowledged that he "knew nothing about aircraft" at the beginning of the war. This lack of expertise meant that Baker was unable to judge effectively the merits of many of the programs submitted to him, while circumstances forced him to rely on the advice of men who actually knew little more than he did. Baker appointed these men to positions where they could control the aircraft program, then stepped back and let them work without providing a strong hand to guide their deliberations. In these circumstances, confusion and delay were inevitable. Baker was also reluctant to advocate the creation of powerful executive agencies that might disrupt the traditional organization of the business community or interfere in Army procurement matters in ways he could not
control. The absence of a strong, knowledgeable leadership was to plague the aircraft production program throughout the war.\textsuperscript{5}

A third problem that affected policy makers was the failure to gather information on the condition of aviation on the Western Front. The European powers were reluctant to give Americans free access to their aviation secrets. The Americans, not recognizing the opportunity the war presented, chose not to pressure the warring powers into allowing American observers to join their armies. The only step taken, according to Major Benjamin D. Foulois, was to send Major William Mitchell to France "either in the fall of 1916 or the early spring of 1917."\textsuperscript{6}

The United States was not totally unaware of European aviation developments, however. American industries had been producing a small number of European designed planes and engines under contracts with England and France. However, information gained from this contact was not used to try to keep American developments in line with the state-of-the-art. Furthermore, no attempt was made to determine the number and types of aircraft required for a major war effort, based on the knowledge of what was needed by the European combatants. Prior to American entry into the war, there was no systematic attempt made to study the lessons of the European experience.\textsuperscript{7}

The overall situation in the United States throughout
the first quarter of 1917 reflected the results of more than a decade of official neglect and disinterest in aviation matters. The outbreak of the war found the United States totally unprepared to meet the demands thrust upon it. Washington was a madhouse, the scene of feverish, undirected activity. Those involved in the early stages of the aircraft program knew little of what was expected, less of how to achieve it. Ten years of bureaucratic lethargy had to be shaken off in a matter of days. Initial attempts to bring order out of this chaos centered around the creation of the bureaucracy that was quickly thrown up to oversee the formation of the production program.

Many of the major elements of this bureaucracy grew out of the work of the pre-war Industrial Preparedness Committee, chaired by Detroit businessman Howard E. Coffin. The initial work of this committee was to make an "inventory of the manufacturing plants of this country that were capable of making munitions." It appears that Coffin financed this effort initially from his own pocket. Coffin himself took special interest in the requirements of aviation work, although he had no aeronautical experience. He recognized that an agency was needed to control all aspects of the aircraft program, and suggested to Secretary of War Baker that a commission of some sort be established to oversee aircraft work. The Coffin plan for a "commission" became the Aircraft Production Board with Coffin as its head.
The work of the Industrial Preparedness Committee involved those elements of the economy that would actually produce aircraft and engines when the war came. Various scientific and technical bodies, also established before the war, tried to gather the technological information that had become available and distribute it to those agencies that needed it.

The first of these, the National Advisory Committee for Aeronautics, was created by an act of March 3, 1915. This body was formed to supervise and conduct research in aeronautics. In its wartime service, this association of technical experts acted as a clearing house for inventions submitted to the Army and Navy. It also constituted a source of general information for the aircraft industry. The Committee had nothing to do with the formulation of the aircraft program or with decisions as to the types of planes or engines chosen for production. The major activity of NACA during the war was assisting in securing the cross-license agreement for the payment of royalties for the use of patented inventions pertaining to aircraft.\(^9\)

The Joint Army and Navy Technical Aircraft Board, composed of Army and Navy officers, was the agency that was to assume responsibility for the outline of the basic aircraft program. The aircraft program as it developed was officially based upon the recommendations of the Board. The Board was a purely advisory body, formed in May, 1917, to standardize the designs and general specifications of aircraft. A body
of this type was suggested by NACA, and its creation was approved by the Council of National Defense. The members of this board were theoretically the best scientific and technical minds available to the Army and Navy. They were the representatives of the small pool of aviation experts available to the armed services and were the nucleus around which the program was built. Unfortunately, the recommendations of the Board were often ignored. Their role as an advisory body without any real power was accepted quite literally by those who came to make the actual decisions regarding procurement and production.¹⁰

Information flowed to the Joint Army and Navy Technical Aircraft Board and thence to the War Department through a variety of ad hoc civilian boards and commissions, created after the start of the European war to oversee American production, including the aircraft program. The Council of National Defense was created in late 1916 to supervise business affairs between the Army and industry. (Prior to 1916 the General Staff was forced to rely on informal contact with influential men in commerce and business.) The members of the Council included the Secretaries of War, serving as chairman, Navy, Agriculture, Labor, Commerce, Interior, a planning coordinator, and an Advisory Commission composed of businessmen whose job was to provide information to the government.¹¹

Initially, the Council sought to plan how businessmen
might best affect the concentration and mobilization of the nation's resources in time of war. Even in late 1916 there seemed little reason for haste, and a three year plan was devised calling for, first, a general survey of the industrial situation, and second, a more specific examination of the role of particular industries in military government. Finally, in the third year, if the world situation still remained dangerous, appropriate plans would be put into effect. Secretary Baker, who had great authority in his dual role of Secretary of War and Chairman of the Council of National Defense, chose not to exercise his power and create a strong planning arm. The Council maintained a subordinate and advisory role to the War Department. It never developed into a powerful directing agency for the war effort.\(^{12}\)

The War Industries Board, created July 28, 1917 by a resolution of the Council of National Defense, was formed to assist in the coordination of all government needs. The Board adjusted the prices, sequence, and relative urgency of commodities required, dealt with labor shortages, technical aspects of industrial problems, and related matters. Decisions made by the War Industries Board could have hamstrung the aircraft program if certain commodities, most especially lumber, had been diverted elsewhere. This did not occur to any great extent. The failure of the aeronautical plans can not be blamed on serious, prolonged shortages of materials.\(^{13}\)

The body that was to have the most direct control over
the aircraft production and procurement program was the Aircraft Production Board and its successors. Howard E. Coffin had suggested that a commission be created to manage the aircraft program. The Council of National Defense therefore created in May, 1917 the Aircraft Production Board. Coffin was appointed chairman of the Board, and he chose the civilian personnel who served with him. He selected Edward A. Deeds, Sidney D. Waldon, and Robert L. Montgomery. In addition to the four civilian members, the Chief Signal Officer, Brigadier General George O. Squier and Admiral David W. Taylor, Chief of the Bureau of Construction were appointed to represent the Army and Navy. 14

The Aircraft Production Board was "charged with coordinating the designs for Army and Navy aircraft and engines in addition to cooperating with the military services to remedy difficulties in production." Its functions also included advice in connection with coordination of foreign designs, arrangements with factories for production, control of production facilities to insure that they were in full use, inspection, construction of aviation schools and supply depots, and establishing the priority of deliveries. The Board approved the advance of government funds and cost-plus contractual agreements. The critical role of the Aircraft Production Board cannot be overestimated, since the facets of the program that came under the most severe attack as production faltered are the ones most intimately connected
with the decisions of the Board.\textsuperscript{15}

While the Board had no authority to commit the government, it was continually active in the formulation of programs and resolutions of advice. The Aircraft Production Board was the prime mover in the investigation of manufacturing concerns and in recommending to the Army which companies should receive contracts for engine and airframe production. Although this was only an advisory body, research indicates that all its recommendations were normally approved. The Army was the responsible contracting agent, furnishing the Navy and other agencies with equipment from total production.\textsuperscript{16}

It is interesting to consider the intricacies and redundancy built into this system. Representatives of the Signal Corps actually signed the production contracts with the chosen manufacturing concerns. The contract had been officially sanctioned by the Joint Army and Navy Technical Aircraft Board, which had gotten advice on numbers, types, and suitable contactors from the Aircraft Production Board. Although the advice of the Aircraft Production Board was accepted almost without question, it was not officially responsible for its suggestions. Officially, it could only give advice, and no other agency was under any compulsion to accept any of its recommendations. Military men in the Joint Army and Navy Technical Aircraft Board and the Signal Corps had to accept full responsibility for decisions made by other
The Aircraft Production Board was superceded by the Aircraft Board, which was established on October 1, 1917. The Board had nine members, three from the Army (Squier, Deeds and Montgomery), three from the Navy, and three civilian representatives, one of whom was Howard E. Coffin. The Aircraft Board assumed all of the functions of the Aircraft Production Board, including its status as an advisory body, having no power to make contracts. Contracts were to be made by "the already constituted authorities of the respective departments." The Aircraft Board, therefore, became a clearing house for proposals from the Signal Corps and other agencies, and it was dependent on the Signal Corps for final approval and execution of its recommendations. The reason that the authority of the Aircraft Production Board and the Aircraft Board was so narrowly defined was Secretary of War Baker's desire to insure that the actual control of aircraft production rested with military officers.  

As a result of the breakdown of the production program in late 1917 and early 1918, the decision was made to remove all phases of air operations from the Signal Corps. This was effected by a Presidential Order of May 20, 1918. The Air Service was placed under the control of Brigadier General William L. Kenly, who was appointed Director of Military Aeronautics. His section had roughly the same duties as the Aviation Section of the Signal Corps with one important exception.
The production decisions that had previously been made by the Aviation Section were now the responsibility of the newly established Bureau of Aircraft Production. The Division of Military Aeronautics was a military body. It assumed responsibility for personnel, training, and setting performance requirements for material. The Bureau of Aircraft Production was run by civilians, concerned only with the quantity production of aircraft suitable for service with the Division of Military Aeronautics. The Bureau of Aircraft Production had six divisions, including Airplane Engineering, Production, Administrative, Procurement, Finance, and Plant Protection. Ten district offices tried to solve minor production problems in the field. The Bureau eventually employed 842 officers, 3,646 enlisted men and 8,969 civilians.

As an organization the DMA/BAP system was a vast improvement over the system established by the Signal Corps. Unfortunately, it evolved too late to save the aircraft program.  

The basic structure the Signal Corps used while it controlled the aircraft program was established on July 24, 1917, when authority was given to the President to "provide through the War Department for the purchase, manufacture, maintenance, and operation of all types of aircraft, with the necessary equipment." Under the Secretary of War the authority to establish the aircraft program and the control and administration of matters relating to the aircraft program was vested in the Chief Signal Officer, Brigadier Gen-
eral George O. Squier. On August 2, 1917, the Equipment Division of the Aviation Section of the Signal Corps was established. Its head was Edward A. Deeds; his chief assistant was Sidney D. Waldon. The Finance and Supply Division, under Robert L. Montgomery was created at the same time. Since all three businessmen were now working in the Signal Corps, they were commissioned as colonels in mid-August, 1917. Refinements were made in the structure on August 29, 1917, although the personalities involved remained the same. Colonel Deeds, as head of the Equipment Division, had direct charge under the Chief Signal Officer of all matters relating to aircraft production. It was this organization that was replaced by the Division of Military Aeronautics and the Bureau of Aircraft Production. 19

Secretary Baker's drive to maintain the accepted way of transacting business in the face of the revolutionary demands made on this system played a major role in the failure of the procurement program. The arrangements made by the Signal Corps reflected the lack of expertise on the part of those who dominated the bureaucracy. The Corps did not know what was expected of the airplane as a weapon or of the production program. However, few in the Signal Corps claimed to have the expertise necessary to carry the program that was handed to it in the early days of the war to a successful conclusion. The frequent reorganizations reflect the confusion that confronted General Squier and his asso-
ciates. Although Squier and those under him were blamed for the failure of the program, its failure was not solely their responsibility. Secretary Baker, who maintained his conservative methods in the face of the convulsive changes the war forced on the American government, must bear the ultimate responsibility for the bureaucratic insufficiency that appeared in the later months of 1917.

The names of Deeds, Waldon, and Montgomery appear frequently throughout the period, both as responsible officials in the Signal Corps and as popular scapegoats for the failure of the program. The career of Edward A. Deeds, who, as head of the Equipment Division had nominal control of the aircraft program, demonstrates why this is so.

Deeds, a native of Granville, Ohio, came to Washington from Dayton, Ohio, where he had been an officer of the National Cash Register Company. As an officer of NCR, he had been indicted in 1912 for violating the Sherman Anti-Trust Act. He was convicted, although the case was reversed on appeal and later dropped. He came to Washington at the request of Howard E. Coffin to serve on several advisory committees that planned all phases of the war effort.\(^20\)

The idea that industrial leaders could be used as temporary planners was not new. Others had suggested that: "Industrial men of known responsibility and capacity for the particular work must be selected. They should be particular-
ily fitted for the positions they occupy and should be respon-
sible for their work as in civil life." Deeds' rise to
prominence as an aviation expert is revealing. He and Charles
A. Kettering had formed the Dayton Engineering Laboratories
Company (DEILCO) to manufacture a new ignition system for
automobiles. Deeds was president of this company. Deeds
and Kettering were also involved with the Dayton Metal Pro-
ducts Company, which made fuses under contract to the Army,
Navy, and the British government. Because of his work with
fuses, Deeds went to Washington as a member of the Munitions
Standards Board subcommittee on fuses and detonators. In
1917, Dayton Metal Products Company acquired all the stock
of the Dayton-Wright Airplane Company. It also subcontracted
with several other aircraft manufacturers to supply metal
parts. Dayton Metal also purchased 1,000 shares in the Lin-
coln Motor Company of Detroit. Dayton-Wright and Lincoln
had both been organized in expectation of receiving govern-
ment contracts. In 1916, Deeds and Kettering organized the
Domestic Building Company of Dayton, which owned the land
and built the principal plant for Dayton-Wright. Therefore,
through his connection with Dayton Metal Company, Deeds had
an interest in several concerns that would soon be seeking
government contracts. Deeds claimed to have disposed of his
Dayton Metal Products stock. He did transfer the stock to
his associates, including Kettering, but was never paid for
it. Chief Justice Charles Evans Hughes questioned the propriety of the transactions, but could find no civil criminal activity. He did recommend court-martial, since Deeds had apparently violated Section 41 of the United States Criminal Code, which made it illegal for an agent of the federal government to have an interest in a company he might have dealings with in an official capacity. Secretary of War Baker conducted his own investigation and exonerated Deeds.22

It appears that the members of the Aircraft Production Board and its successors had confidence in those firms that were recommended for contracts. They were concerns that Deeds and his associates knew well. They believed that, based on past performance, these firms would be able to produce what was expected of them. However, the fact that Colonel Deeds' former business associates were placed in a position where they were assured of very large profits at government expense created a feeling of distrust that found frequent expression throughout the period.23

One of the results of this feeling of distrust was the growth of popular sentiment that condemned the alleged Dayton-Detroit conspiracy that controlled the aircraft program. People believed that these two groups had assumed control of the aviation industry before the war and were prepared to use it to make exorbitant profits at government
expense when war came. In the public mind, Deeds represented the Dayton interests in a larger Detroit group, headed by Coffin, a vice president of the Hudson Motor Car Company. The Detroit representatives wanted to insure that the plants of the automobile industry were filled with aviation orders when the United States entered the war. To this end, Coffin and Deeds, in Washington, blocked the "efforts of dozens of competent engineers and manufacturers of aircraft to assist the government."\textsuperscript{24} According to proponents of this theory, all the pieces were in place by April, 1917. The Dayton-Detroit conspiracy had "infiltrated the Washington bureaucracy." They had noted the importance of aviation in Europe and the obvious weakness of military aviation in the United States. "The flow of government funds had to be started, and Coffin and his group were prepared to use this small industry as a lever to get a billion dollars out of the government. With the hope of enormous federal appropriations ahead, the scene was set for the boon of war profits."\textsuperscript{25}

It is clear that this theory presupposes an existing, healthy aviation industry that was eventually blocked out of the initial aviation effort by the machinations of the auto interests. In fact, the aviation industry in the United States before the war was in no condition to make a major contribution to the aircraft program. In 1914, there were sixteen firms important enough to be listed by the Census
Bureau as aircraft manufacturers, but their combined output for the year was 49 planes. Only four companies had successfully produced aeronautical engines in the United States prior to April, 1917. These companies were the Hall-Scott Company of Berkley, California, the Curtiss Aeroplane and Motor Corporation of Buffalo, New York, the Wright-Martin Aircraft Corporation of New Brunswick, New Jersey, and the General Vehicle Company of Long Island City, New York. ²⁶

In 1917, the entire aviation industry had a rated capacity of 7,200 machines a year, representing an investment of only $20,000,000. Much was expected of this tiny industry by both American planners and the Allies, one of whom, Great Britain, had an estimated capacity of 40,000 machines a year, with an investment of $375,000,000. But this same small industry was to receive almost $1 billion in approximately eighteen months. ²⁷

According to the initial plans of the War Department, the existing plants in the United States were to be allocated as follows:

**TABLE 3**

**AVIATION PLANT ALLOCATION, 1917**

<table>
<thead>
<tr>
<th>Plants Available for Army</th>
<th>Plants Available for Navy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curtiss, Buffalo, N. Y.</td>
<td>Curtiss, Buffalo, N. Y.</td>
</tr>
<tr>
<td>Standard Aircraft Corp.,</td>
<td>Burgess Co., Marblehead,</td>
</tr>
<tr>
<td>Elizabeth, N. J.</td>
<td>Mass.</td>
</tr>
</tbody>
</table>
Plants Available for Army

Thomas-Morse, Ithaca, N. Y.
Sturtevant Aeroplane, Boston, Mass.

Plants Available for Navy

Lowe, Willard, and Fowler Engineering, College Point, N. Y.
Aeromarine Engineering, N. Y., N. Y.
Gallaudet Aircraft, N. Y., N. Y.
Boeing, Seattle, Wash.

Of these, only Curtiss, Standard, Burgess, LWF, Thomas-Morse, and Wright-Martin had built more than ten machines. Two full size plants were to be built with government funds, one by the Fisher Body Company in Detroit, the other by Dayton-Wright in Dayton, Ohio. These concerns were to be the prime contractors. Spare parts contracts went to even smaller aircraft plants and the auto makers.28

The dominance of two companies, Curtiss Aeroplane and Motor and Wright-Martin Aircraft was due in large part to their ownership of important patents. Curtiss was the larger of the two. Incorporated in January, 1916, although it had been producing planes for some time, Curtiss was building training aircraft, especially the JN-4 series, for the Army and Navy before the war. In 1917 it was rather disorganized. Before it invested millions in reorganization and expansion it sought assurances that it would receive contracts. It also sought government financing for its $5,000,000 North Elmwood plant in Buffalo.29

The Wright-Martin Aircraft Company was also organized in 1916, the result of the merger of the Wright Company and
the Glenn L. Martin Corporation. In that year it acquired American rights to the Hispano-Suiza engine. It was slowly producing these engines on a French contract. Since the firm was unsure of military aircraft production orders, it had also set up to build two Simplex autos a day.\textsuperscript{30}

All elements of the industry depended for their existence on one customer, the United States government. By 1916, most of these firms were marking time, not knowing if extensive government contracts would be forthcoming. When the massive demands of wartime production arrived, the government had to create an industry. This meant not only equipping factories, but the procurement and sometimes actual production of raw materials. To get around this problem, the Signal Corps looked for other possible sources of production. A survey which had been made by the Council of National Defense had indicated that the automotive industry could handle a great deal of aircraft work, particularly that of producing engines and metal parts. The automobile people knew nothing about aircraft design, production methods or the demanding system of inspection that made aircraft production so difficult. The auto makers discovered what most aircraft producers already knew; aviation was not a mass production industry. For this reason, the auto makers ran into immediate problems when they were asked to produce aircraft.\textsuperscript{31}

The auto industry was given a major role in the air-
craft production program and its representatives dominated the planning boards. This was due to the theory that aircraft engine and plane construction were similar to automobile manufacture. The boards depended on automotive engineers and manufacturers for the solution of aviation problems. But the analogy between the two pursuits begins and ends with the fact that both used a gas-explosive motor. Difficulties in design and production increased until this condition was recognized. The automotive industry did excellent work on aviation engines, but its performance on airframe construction was dismal.

The war brought what would now be called a "crash program," a subject of bitter dispute at the time and for years afterward. While the program was not the fiasco its critics alleged, it did little either to win the war or advance aviation. The industry was unprepared to take up the tasks presented to it, but by the end of 1918 a production rate of about 23,000 planes a year was reached, and 175,000 people were employed in aircraft manufacturing before the program was halted. Only a small part of the total output could be credited to companies that had been in the aircraft business before the war. The engines came primarily from the automobile industry. The airframes came from a variety of firms, some organized for the specific purpose of securing war contracts.\(^{32}\)
NOTES


2. Ibid., p. 235.


12 Ibid., p. 54.

13 The Signal Corps and Air Service, p. 36.


21 Letter, Archer A. Landon to Howard E. Coffin, Octo


24 Freudenthal, Aviation Business, pp. 32-38; Crow
dell, Government War Contracts, p. 234.

25 Freudenthal, Aviation Business, p. 34.


27 Freudenthal, Aviation Business, p. 37.

28 Table 3 and related material compiled from Mixter
and Emmons, *Aircraft Production Facts*, pp. 43-44.


CHAPTER II
Roots of the Program

What production planning occurred during the early months of the First World War demonstrated how unprepared and ill-informed the Army was about the requirements of a major aviation program. Estimates were made and programs were approved that were clearly beyond the capabilities of American industry. Information on the state of the industry was available, thanks to the work of the pre-war planning and survey commissions, but it was ignored. The public wanted programs and numbers, quickly. Questions about performance would come later.

In April, 1917, the control of aviation was in the hands of a small Aviation Section of the Signal Corps. When it became evident that the United States was on the verge of war, the section began formulating its plans and estimates. In the case of the older, established branches of the service, the planning process was not so difficult since standards already existed and changes were quantitative. The Aviation Section was unable to draw on past experience. In January, 1917, the Section suggested that 1,000 planes could be built in one year. By March, this figure had grown to 2,500 planes a year and soon after
reached 3,700. On March 29, 1917, the National Advisory Committee for Aeronautics produced a program that called for the production of 19,070 service and training planes over a three year period. These schedules were not officially adopted, but they do show how rapidly the production estimates grew.¹

During the early days of the war, the Wilson Administration seemed obsessed with large numbers. America was known for its mass-production techniques. The administration assumed that aircraft and engines could be turned out as quickly as automobiles and bicycles. Wilson, Baker, and their subordinates associated bigness with America. Therefore, why not a huge aircraft program? Most officials assumed that it would be relatively easy to produce a large number of aircraft. Baker announced that Congress would be asked for six hundred million dollars to build the "greatest air fleet ever devised." He informed President Wilson that he was "thoroughly fascinated by the possibilities of the thing." Colonel Edward M. House advised President Wilson: "If you give the word, and will stand for an appropriation of one billion dollars, the thing is done." Congress, mesmerized by the vision of clouds of American aircraft, voted the appropriation after a short debate. It was the largest single appropriation voted by a Congress to that date.²
The money was appropriated before the Signal Corps had formulated any detailed production programs. The programs that were hastily devised were based on a variety of sources, among them foreign advice, American overseas investigations, and uneducated guesses about the projected need for aircraft. The programs were not based on a rational examination of the capabilities of American industry. Any systematic attempt to use the existing and planned industrial capacity as a basis for the planning process would have produced a final program with limits much different from the one that was actually formulated.

As soon as the United States entered the war, Great Britain, France, and Italy who had jealously guarded all information regarding the development and use of the aircraft since 1914, became willing to give the United States what information and advice they could. Within three weeks, large and well staffed missions from both France and Great Britain had arrived in Washington to help arrange for full American participation in the fighting in Europe. The aviation sections of these foreign missions had several objectives. They hoped to obtain all forms of resources, such as spruce, plywood, fabric, and oil for their own industries. They wanted to arouse enthusiasm for a large American aviation program. Engineering sections of the missions sought to exchange technical data, although the bulk of the data came
from the Europeans because the Americans had very little information to offer. They also hoped to be able to train large numbers of pilots and mechanics in the United States. Another function of somewhat lesser importance was to disseminate pro-Allied propaganda. This task was quickly assumed by the American Committee on Public Information.³

The British War Mission arrived first, on May 31, 1917. Headed by Lord Northcliffe, the Aeronautical Supply Department was under the control of Brigadier J. D. Cormack. On June 12, Major General W. C. Brancker, Director General of Equipment at the Air Ministry, began a six week visit. General Brancker came to check on the work of the British Mission assigned to Washington and also to gather information about the American situation. What he discovered must have surprised him.⁴

The activities of Brigadier Cormack's section serve to illustrate the work done by similar missions from other countries. The section gave the Americans access to confidential bulletins from the Air Ministry's Technical Department. It provided samples of captured German equipment, arranged tours for American engineers and officers through English aviation camps and aircraft shops, and functioned as a clearing house for the technical experts and manufacturers. The section served as a conduit for information on British production and American programs and handled the distribution of blueprints of English equipment to American manufac-
turers. In Washington, Cormack's aviation section served as the official contact between the two governments on aircraft matters and coordinated the procurement of raw materials.\(^5\)

The French Aviation Mission, under Lieutenant Colonel Joseph Tulasne, arrived in the United States within days of the British on April 24, 1917. The French supplied a wide variety of technical data, including information on how the French had organized for aircraft production work. The Italian Aviation Mission arrived in late June, 1917, complete with sample engines, aircraft, accessories, and test pilots and skilled mechanics. Engineers were also sent to push conversion of Italian types to the Liberty engine. Before the end of August, 1917, the United States was also visited by missions from Belgium, Russia and Japan.\(^6\)

The well-meaning advice of the foreign missions did not solve the immediate problems facing the American planners. Since exact requirements were still unknown, there was no consensus on how large a program would be necessary. The first Air Service program for the American Expeditionary Forces called for 120 pursuit, 80 observation, and 60 bombing squadrons. The program did not suggest any specific types for production. The question of the size of squadron establishments was debated until May, 1918, when General John J. Pershing recommended that each observation squadron consist of twenty-four machines, each pursuit and day bomb-
ing squadron twenty-five planes, and each night bombing squadron ten aircraft. He also suggested that reserves should equal one-third of the total establishment, and that another third be provided for both "wastage" and training during the first month of service. This meant that each squadron would require double the number of planes initially called for. Experience showed that monthly maintenance required approximately two-thirds of the original number of planes. 7

The Aircraft Production Board, in trying to draft a program for an effective air arm without adequate information floundered for almost a month. Then, on May 24, 1917, a cablegram was received in Washington from the French Premier, Alexandre Ribot. America's World War aeronautical program grew out of this cable. The cable sounds more like an order than a suggestion:

It is desired that in order to cooperate with the French aeronautics the American government should adopt the following program: The formation of a flying corps of 4,500 airplanes, personnel and material included, to be sent to the French front during the campaign of 1918. Total number of pilots, including reserves should be 5,000 to 50,000 mechanics.
Two thousand planes should be constructed each month, as well as 4,000 engines by the American factories. That is to say, in the first six months of 1918, 16,500 planes of the latest type and 30,000 engines will have to be built. The French Government is anxious to know if the American Government accepts this proposition, which would allow the Allies to win the supremacy of the air.

Ribot 8
This request was referred to the Joint Army and Navy Technical Aircraft Board. A report was rendered May 29, 1917, which stated that in order to comply with the French request, the United States Army would require in Europe 9,000 combat aircraft with 3,000 reserves, plus 24,000 engines. This equipment was to be produced between January 1 and June 30, 1918. Combined with 9,900 training planes, the program called for 22,000 planes and 43,800 engines in one year.9

On June 13, 1917, the War Department asked the Council of National Defense to comment on the practicality of the program. The Council was to decide if the United States could comply with the wishes of the French government "without undue interference with or disorganization of the industries of the United States." An answer was received within days. The reply stated that the program submitted to the Aircraft Production Board was a gigantic one, but capable of accomplishment as outlined provided funds were quickly appropriated and no delays permitted.10

The magnitude of this plan is staggering when it is compared to estimates made by other bodies at the same time. The National Advisory Committee on Aeronautics had recommended a program on April 12, 1917 that called for producing 3,000 planes in 1918, 6,000 in 1919, and 10,000 in 1920. The new proposal called for between 11,000 and 15,000 planes in six months. In an atmosphere of great pressure, a group of
Army officers under Benjamin D. Foulois were told to draft a detailed program based on the Ribot cable. "The one thought was the supreme opportunity and the supreme need for haste." The proposal was to include "an estimate for the necessary funds to cover the purchase and production of the necessary material and all the items in connection with training stations, land, and whatever conceivable item would possibly be needed in the carrying on of the program." The program provided for 22,655 airplanes and almost 44,000 engines plus eighty percent spare parts, which equalled another 17,600 airplanes and 35,200 engines. Although 12,000 were to be for use in France, the exact types were not yet known.\textsuperscript{11}

Some of the military planners were not satisfied that the program could be accomplished in the specified time. They acquiesced in the program, however, because they felt that the specialists on the Council of National Defense and the Aircraft Production Board were best qualified to judge the manufacturing capacity of the country. They also decided that the importance of a thriving aviation industry in the United States was so important that the program, even if not completely realized, would constitute a project that would contribute to the establishment and maintenance of aerial supremacy. On June 27, 1917, this plan was formally approved by the Secretary of War.\textsuperscript{12}

The Foulois plan suggested an appropriation of $707,541,000. Cuts reduced it to $639,241,252. This amount
was incorporated into the appropriations bill sent to Congress. Before Congress, Secretary Baker gave an impassioned speech in support of the appropriations bill. "It lives up to America's tradition of doing things on a grand scale. It will put us on our mettle from the point of view of mechanical ingenuity and individual daring and initiative. The War Department is behind this program with every ounce of enthusiasm at its command." Congress moved with unusual haste to get the bill passed. It passed out of the House committee on July 13, was debated in the House on July 14 and passed the same day. The bill came before the Senate two days later and was passed unanimously on July 21. The President signed the bill into law on July 24, 1917. The Aviation Section had $640,000,000 with which to "darken the skies over Germany."  

As Allied military commissions streamed into this country and planners debated the size of the coming effort, the administration sent several fact finding missions to Europe to examine conditions there. In late April, 1917, over one hundred American mechanics were sent overseas to gain experience in European engine and airplane plants. In mid-June, the most important of the American missions sailed for Europe. Headed by Colonel Raynal C. Bolling, this body's report was to profoundly influence the final outline of the aircraft program. 

With a huge aircraft program authorized and soon to
be financed and many conflicting reports pouring in from the various foreign war missions and American officials overseas, it became clear to the Aircraft Production Board that more systematic information was needed. The Board suggested that a large, well organized mission be sent overseas to survey the aircraft situation there and determine what were Europe's most effective types of planes and motors. This mission could then produce a detailed program best suited to America's resources. It would also handle the technical, legal, and diplomatic phases of the situation to promote cooperation between the Allied air forces and develop a concerted construction program among the Allies. The Bolling Aeronautical Mission was therefore organized in May, 1917 to go to Europe to investigate aeronautical conditions.\textsuperscript{15}

Bolling was instructed to investigate both industrial and military conditions with particular emphasis on rapid development of requirements at the front. Since the United States was so far from the front, it was essential that developments should be anticipated whenever possible so that by the time American material reached the front it would not be obsolete or obsolescent.\textsuperscript{16}

The Bolling Mission was composed of 104 aircraft specialists, two from the Army, two from the Navy, seven civilian scientists and engineers and 93 production workers from a variety of factories who would study production techniques. The members of the Mission received a whirlwind
tour of Europe. They sailed from New York on June 17, 1917, arrived in England on June 26, visited France, and departed Italy on July 27. Included among the members of the Mission were Captain Virginius M. Clark, "the Army's best aeronautical expert," and Commander G. C. Westervelt, "recognized as the Navy's leading aeronautical engineer." Colonel Bolling was given two letters of introduction from Secretary of War Baker, one introducing him as a military man, and the other as a civilian. The idea was that he would use his military letter whenever such rank would be sufficient and his civilian letter whenever his rank was too low to give him sufficient prestige when dealing with the highest civilian authorities. The scope of Bolling's mission made this formality necessary.17

The Bolling Mission's most important task was to secure samples and blueprints of all the airplanes, motors, and accessories which could be considered valuable for American production. It was also to establish an "understanding" on which to base future negotiations on resources. A third objective was to stimulate a policy leading to standardization of all Allied material so that parts could be made interchangeable. Other goals were a reciprocal trade agreement so that the United States could avoid paying excessive royalties to European patent holders, and Allied acceptance of a plan whereby the United States would build its own
trainers and buy its fighters in Europe. In return, the United States would supply engines, which had become a major choke-point in the European production system.\textsuperscript{18}

Bolling was well aware of the importance of his mission to the American procurement program. In a letter from Howard E. Coffin, he was told that "The speed with which the United States launches its aircraft program depends largely on you. Your good judgement and tact may easily bring results of the greatest international importance ... Get all the facts before recommending a decision and remember that our motto is 'VITE.'\textsuperscript{19}

This concern with speed had a disastrous effect on the aircraft program. Bolling and his colleagues did try to "get all the facts," but the need for haste resulted in decisions that were to cripple the production effort. Their recommendations on the general course of production were most reasonable and carefully considered. However, their choices of specific aircraft types chosen for production were less fortunate and show how excessive speed helped to wreck the program. The members of the Bolling Mission chose planes that were then in service because they did not have time to examine in detail European research and development work. As conditions at the front changed, the role and value of these planes changed also. Unfortunately, conditions in America were such that the program had to sink or swim with
these types. American factories had to produce them or nothing.

The members of the Bolling Mission examined the situation assiduously, and their final report formed a major part of the data upon which the final aircraft production and procurement program was based. According to their final report, dated September 4, 1917, the Allies had well trained and experienced air forces in the field. American production had to be developed so as to maximize material aid to Europe. This could best be done by initially shipping raw and semi-finished materials to Europe. Next, America would manufacture finished parts for airplanes so the Allied plants could concentrate on final assembly. Finally, engine production would be pushed, since this was a severe limiting factor in the Allied air programs.²⁰

Bolling suggested that American aircraft requirements could best be met by a three phase program that would stress the gradual development of American production capacity. Initially, the best of the contemporary English and French types could be purchased abroad. These planes would be built from material shipped from the United States. Concurrently, America would concentrate on producing engines and training aircraft for its own purposes. In phase two, the United States would begin to build its own service planes for use at the front. The size of the phase two production effort
would be based on the size of the American Expeditionary Force. In the last phase, American production would increase the size of the combat air force beyond the minimum aviation requirements of the A.E.F. ²¹

Bolling believed that July 1, 1918 would be a turning point in the aircraft program. He was convinced that, given the state of American industry and the shipping situation, American aircraft and engines could not be delivered to the front in quantity before that date. After July 1, he believed that American production would supply America's needs as well as those of her Allies. In surveying the European situation, Bolling noted that: "In considering the period between now and July 1, 1918, due weight must be given to the experience of all foreign countries and manufacturers in the delays in airplane and engine production which were not and could not be foreseen. Only at close hand can one appreciate how many and how great the delays have been." Unfortunately, Bolling's implied warning was ignored. ²²

The Bolling Mission had also recommended several types of European aircraft that were to be considered for American production. These included the Bristol Scout with an 80 horsepower Le Rhone engine, to be used for advanced training, the Bristol Fighter with a 200 HP Hispano-Suiza, the DH-4 for reconnaissance and day bombing, with a Rolls-Royce or similar engine, the Spad fighter, also with a 200 HP Hispano-
Suiza, and the New Spad, then being tested, with a 150 HP Gnome engine. The American heavy bomber was to be the Caproni triplane, with three engines of a type to be determined later. It is important to note that these European types were to be built in American plants. This included both the airframes and the engines. These were the aircraft types that were mentioned in the detailed production programs conceived by the American government in the early months of the war.23
NOTES

1 Signal Corps and Air Service, pp. 38-40.
2 Beaver, Baker and the War Effort, p. 58.
5 Ibid.
6 Ibid., pp. 1280-1281, 1281-1285.
7 Signal Corps and Air Service, pp. 75-77.
8 War Expenditures: Hearings, I, p. 358.
9 Signal Corps and Air Service, p. 43.
10 Ibid.
12 Signal Corps and Air Service, pp. 43-44.
17 Edgar S. Correll, The Measure of America's World War Aeronautical Effort. James Jackson Cabot Professorship Lecture No. 6, Norwich University, delivered November 26, 1940. (Burlington, Vermont: The Lane Press, Inc., 1940),
p. 3; MSS "History BAP," V, pp. 1287-1288.


CHAPTER III
Numbers and Types: The Program Takes Shape

By mid-September, 1917, the basic outline of the American aviation program had been set. The Ribot cable had suggested the size of the American contribution, and funds had been appropriated based on its recommendations. The final report of the Bolling Aeronautical Mission designated European types to be produced in American factories. Some of its recommendations, however, were outdated by the time they were received. The most important change was the elimination of the phased introduction of American made parts and planes into the existing system. The Ribot cable had suggested that the Americans immediately begin producing planes and engines in their own plants, and this idea was approved. There were other important decisions regarding the details of the program that effectively ignored the recommendations of Bolling and his colleagues.

The selection of types chosen for construction was modified by the desire that the United States come into the manufacturing program several strides ahead of the European state-of-the-art. Planners wanted to insure that American equipment was not out of date when it reached service. The
attempt to stay ahead of the European situation had an unfortunate impact on the course of the American production effort. An example of the problems inherent in this decision was the continuing confusion over the adoption of a single-seat fighter throughout 1918, which led to the subsequent inability to produce any plane of this type. While the desire to maintain a technological lead over European aviation was well-founded, the resultant confusion leads one to question the merits of the decision. It reflects a distrust of the choices of the Bolling Mission. Rather than rely on these experts to choose types which would remain useful for some time, government planners procrastinated on awarding contracts for any type, fearing something better would appear. This led to confusion in Washington and the factories and upset production estimates. In an effort to provide the best, planners inadvertently took actions that meant that they provided almost nothing.\footnote{1}

The decision that had the most profound negative effect on the program was the one that, at the time, seemed the most reasonable. In the desire to secure quantities of aircraft and engines, planners tended to favor the standardization of a few designs. This was in line with American production methods of the automobile industry. The decision to stress standardization was supported by Bolling: "My personal opinion as to the reason the Allies have no greater mili-
tary benefits with their remarkable developments in aviation, is that they lack quantity production." By manufacturing a wide variety of types, the Allies, and especially the English, were not able to concentrate on the quantity production of any one superior type. At any one time, the British were producing as many as eighteen or more different types, most of which had different engines. Each German technical advance was met by several new designs. To maintain high levels of production, however, the older types often remained in production long after they were suitable for combat. The French and the British used different types of planes and engines, meaning that an advance made by one power led to more design changes on the part of its enemies or allies. The Americans hoped to avoid this problem. However, if production of a few types was to be stressed, their selection was important. The need to select the best types was critical. This led to unnecessary delays, not in planning but in production as frequent design changes were made.²

More importantly, the decision to promote quantity production of standardized types whenever possible led to the decision to design and produce an engine best suited to American production methods. The result was the Liberty engine, and its success created countless problems for the overall aeronautical production effort. It is not an understatement to say that the Liberty engine, or, more formally, the U. S.
Standardized Aircraft Engine, was the principal accomplishment of the American production and procurement effort during the First World War. The Liberty was a sturdy, dependable, high powered engine that was produced by the thousands for over a decade. It was no technological milestone, however. It was designed specifically for immediate large-scale production in existing automobile engine plants. Its designers were expressly enjoined to use only known and tested methods and techniques. What they achieved has been described as an "excellent synthesis of the state-of-the-art at its time."\(^3\)

The United States had the option of adopting one or more of the highly developed European aircraft and engine types then available. This course had been recommended by Colonel Bolling. One reason that the United States did not take this course was an over-inflated sense of pride in American ability and an unwillingness to follow the lead of other nations in a science that Americans felt themselves pre-eminent, the science of building light internal combustion engines. A more compelling reason to design and build an American engine was the demand that America reach maximum production in a minimum of time. An engine designed to take advantage of American production methods and not requiring extensive retooling would further this effort.\(^4\)

The Liberty was a good engine. Powerful and reliable, it was an unpretentious powerplant that was in great
demand during and after the war. Supporters of the Liberty project have waxed eloquent in describing its importance:

The Liberty was a child of war, and it stands today as a monument to the capability of a nation to change and, in changing, to move a giant step beyond its peers in the development of an infant technology. The Liberty was an apology for our nation's lack of foresight and its failure to develop the aircraft born at Kitty Hawk.\(^5\)

However, as events were to show, the success and adaptability of the basic design were to lead to decisions which would paralyze the aircraft program.

The Liberty engine was designed by Elbert J. Hall of the Hall-Scott Motor Car Company and Jesse G. Vincent of the Packard Motor Car Company. Design work was started on May 29, 1917, and the design approved for production on June 4, 1917. The first eight cylinder sample was received at the Bureau of Standards on July 3, 1917. The Liberty was designed as an engine series in four, six, eight, and twelve cylinder models. The four, six, and eight cylinder models were quickly dropped since they offered no significant improvement over already existing engines. Production efforts concentrated on the twelve cylinder model. As produced, this model weighed 845 pounds and produced 400 horsepower at 1800 revolutions per minute, making it one of the most powerful engines for its weight at the time.\(^6\)

The Liberty was designed to be produced by the automobile industry, and it entered production very quickly. The
first flight of a Liberty-8 occurred at Buffalo, New York on August 29, 1917. The Liberty-12 was first flown in an American made DH-4 on October 28, 1917. These were the very earliest production models, and their use does not mean that quantity production had been started at that date. It did not take long for mass production to begin, however.  

The success of the Liberty engine program was well received in Europe. Colonel Bolling wrote that the success of the engine would convince the Allies that America could do the impossible. Europe had not yet developed an engine of its size that was reliable or light weight enough per horsepower to meet their needs, and Bolling thought that it would be in very great demand. Bolling expressed the prevailing feeling of Americans in Europe when he wrote:

You must forgive us overseas if our faith in the United States motor has been a bit faint, because we have been for four months among peoples who have not succeeded in doing anything of that sort, even in the pressure of three years war. Every successful engine has taken a year, or even more, to develop. Many are not yet successful, and very few are both successful and capable of large quantity production.

Since the Liberty was such an immediate success, a large part of American production capacity was devoted to its construction. This meant that the engine types Bolling recommended could not be produced in quantity. To circumvent this problem, the Aircraft Production Board decided that all planes built in America should be modified
to accept the Liberty engine. This decision was extremely
unfortunate. It was a decision to foster quantity output.
Standardization is the essence of mass production. Stan-
dardization simplified tooling, training of labor, manufac-
turing, maintenance in the field and the distribution of
spare parts. But airframes are planned around engines. To
standardize with one engine was to force all designs to con-
form to the characteristics of the engine regardless of the
function or characteristics of the aircraft. The attempt to
fit the Liberty engine into European types prevented quanti-
ty production of a variety of designs. In some cases the
grafting worked: the DH-4 is an example of this. In many
more cases airframes could not handle the increased power
and weight. The United States tried to produce these types,
and failed.9

These policy decisions were the ultimate determi-
nants of the production programs that were drafted in July
and August, 1917. "These programs with their variations and
schedule of deliveries appear to be grotesque in light of the
actual situation, but they bear the imprimatur of the plan-
ning department of the Equipment Division with the counter-
sign . . . of official approval."10

Table 4 summarizes the aircraft and engine types
chosen for production. A comparison of these types and the
recommendations of the Bolting Mission, which were discussed
in the preceding chapter, demonstrates how influential the Bolling report was. Since numbers varied almost weekly, and in some cases daily, they will be discussed separately. For the most part, these types represent the state-of-the-art in aircraft design in mid-1917.

**TABLE 4**

Aircraft and Engine Types Selected For Production, August, 1917

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Training</td>
<td></td>
</tr>
<tr>
<td>Curtiss Standard</td>
<td>Curtiss OX-5</td>
</tr>
<tr>
<td>JN-4D with SJ-1</td>
<td>Hall-Scott A-7a</td>
</tr>
<tr>
<td>Advanced Training</td>
<td></td>
</tr>
<tr>
<td>Bristol Thomas-Morse</td>
<td>Le Rhone 80 HP</td>
</tr>
<tr>
<td>Scout S-4</td>
<td>Gnome 100 HP</td>
</tr>
<tr>
<td>U. S. Training</td>
<td>Hispano 150 HP</td>
</tr>
<tr>
<td>Thomas-Morse S-4B</td>
<td>Gnome 100 HP</td>
</tr>
<tr>
<td>Thomas-Morse S-4C</td>
<td>Le Rhone 80 HP</td>
</tr>
<tr>
<td>Curtiss JN-4H</td>
<td>Hispano 150 HP</td>
</tr>
<tr>
<td>Curtiss JN-6H</td>
<td>Hispano 150 HP</td>
</tr>
<tr>
<td>Penguin</td>
<td>Lawrence 28 HP</td>
</tr>
<tr>
<td>Service, Combat, and Bombing</td>
<td></td>
</tr>
<tr>
<td>Spad</td>
<td>Hispano 200 HP</td>
</tr>
<tr>
<td>Spad</td>
<td>US-8</td>
</tr>
<tr>
<td>Spad Monocoque</td>
<td>Gnome 150 HP</td>
</tr>
<tr>
<td>Martinsyde</td>
<td>US-12 400 HP</td>
</tr>
<tr>
<td>DH-4/9</td>
<td>US-12 400 HP</td>
</tr>
<tr>
<td>Caproni</td>
<td>US-12 (x3) 400 HP</td>
</tr>
<tr>
<td>Handley-Page</td>
<td>US-12 (x2) 400 HP</td>
</tr>
</tbody>
</table>

Subsequently the Martinsyde and Spads were rejected, the production of the DH-9 was first limited and then post-
poned, the Caproni and Handley-Page types were not treated as part of the immediate programs, and the Penguin was found to be unsatisfactory in service. The plans for production centered on the DH-4 and a new entry, the Bristol Fighter with the US-12. Since the programs for the other types were eventually dropped or extensively modified for a variety of reasons, only the DH-4 and the Bristol programs will be examined in detail.\textsuperscript{11}

Captain V. M. Clark of the Bolling Mission's technical staff suggested some modifications in the original program. Examining American technical and technological developments, he recommended that the Liberty-12 be substituted in any plane that would accept an engine of its type. The Aircraft Production Board, the Joint Army and Navy Technical Aircraft Board and the War Department approved the change. With this modification, the program entered its final planning stages.\textsuperscript{12}

The DH-4 program went through eleven variations in seven months:

\begin{table}
\centering
\caption{DH-4 Production Program, Showing Program Goals and Projected Monthly Deliveries}
\begin{tabular}{|c|c|c|}
\hline
\textbf{Program Date} & \textbf{Total} & \textbf{Projected Deliveries} \\ \hline
August 2, 1917 & 8,000 & 25 October, 1917 \\ & & 100 November \\ & & 425 December \\
\hline
\end{tabular}
\end{table}
<table>
<thead>
<tr>
<th>Program Date</th>
<th>Total</th>
<th>Projected Deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 16, 1917</td>
<td>7,500</td>
<td>750 January, 1918</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,000 February monthly increases thereafter.</td>
</tr>
<tr>
<td>August 22</td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td>August 24</td>
<td>6,000</td>
<td></td>
</tr>
<tr>
<td>August 25</td>
<td>15,000</td>
<td></td>
</tr>
<tr>
<td>October 17</td>
<td>250</td>
<td>62 October, 1917</td>
</tr>
<tr>
<td>October 29</td>
<td>1,000</td>
<td>250 November</td>
</tr>
<tr>
<td>February 11, 1918</td>
<td>4,500</td>
<td>1,063 December</td>
</tr>
<tr>
<td>February 19, 1918</td>
<td>8,000</td>
<td>50 December, 1917</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 January, 1918</td>
</tr>
</tbody>
</table>

It is clear that the planning staff had little or no idea how many planes would eventually be needed, or how long it would take to produce them. A similar situation occurred in the Bristol Fighter program:

TABLE 6

Bristol Fighter Program, Showing Program Goals and Projected Monthly Deliveries

<table>
<thead>
<tr>
<th>Program Date</th>
<th>Total</th>
<th>Projected Deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2, 1917</td>
<td>1,000</td>
<td>25 October, 1917</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 November</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 December</td>
</tr>
<tr>
<td>August 16, 1917</td>
<td>3,000</td>
<td>125 January, 1918</td>
</tr>
<tr>
<td>August 23</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>November 26</td>
<td>2,000</td>
<td></td>
</tr>
</tbody>
</table>

Several points must be emphasized. The numbers projected for all these programs represent an attempt to meet
the goals set forth by the Ribot cable. Also, each revision of the program meant that new contracts had to be let or existing ones modified in response to the new situation. This led to chaos in the plants, as schedules were changed almost weekly. The revisions also affected labor and material demands and made fulfillment of any program almost impossible.\textsuperscript{13}

The following firms were the primary contractors for the aircraft and engines. These figures are based primarily on the earliest programs and reflect the status of the aviation effort by mid-August, 1917.\textsuperscript{14}

\begin{table}
\centering
\caption{Airframe and Engine Contractors}
\begin{tabular}{lll}
\hline
\textbf{Type} & \textbf{Contractor} & \textbf{Amount} \\
\hline
JN-4H & Curtiss & 1,000 \\
JN-6H & Curtiss & 500 \\
S4-B & Thomas-Morse & 1,000 \\
S4-C & Thomas-Morse & 400 \\
Penguin & Breese Aircraft & 300 \\
DH-4 & Dayton-Wright & 4,000 \\
 & Fisher Body & 4,000 \\
 & Standard Aircraft & 500 \\
Bristol Fighter & Curtiss & 2,000 \\
\hline
\textbf{Type} & \textbf{Contractor} & \textbf{Amount} \\
\hline
OX-5 & Curtiss & \\
 & Willys-Morrow & 7,950 (3 Firms) \\
 & Willys-Overland & \\
A-7a & Nordyke & Marmon & 2,250 (2 Firms) \\
 & Hall-Scott & \\
\hline
\end{tabular}
\end{table}
<table>
<thead>
<tr>
<th>Type</th>
<th>Contractor</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gnome</td>
<td>General Vehicle</td>
<td>111 (2 Firms)</td>
</tr>
<tr>
<td></td>
<td>Aeronautical Engine</td>
<td></td>
</tr>
<tr>
<td>Le Rhone</td>
<td>Union Switch &amp; Signal</td>
<td>2,250</td>
</tr>
<tr>
<td>Hispano-Suiza</td>
<td>Wright-Martin</td>
<td>2,250</td>
</tr>
<tr>
<td>Lawrence</td>
<td>Excelsior Motor</td>
<td>450</td>
</tr>
<tr>
<td>Bugatti</td>
<td>Dusenberg</td>
<td>2,000</td>
</tr>
<tr>
<td>US-12</td>
<td>Packard</td>
<td>6,000</td>
</tr>
<tr>
<td></td>
<td>Lincoln</td>
<td>6,000</td>
</tr>
<tr>
<td></td>
<td>Ford</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td>Nordyke &amp; Marmon</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>General Motors</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>Trego Motors</td>
<td>500</td>
</tr>
</tbody>
</table>

It does not appear that these contracts were awarded according to any clearly defined principle. The Signal Corps gave contracts to firms that appeared to be able to produce the material. The choice between two similar firms was arbitrary, for the most part. Some firms were awarded contracts they did not want. Firms were refused contracts that were in no better shape technically or financially than firms that were given contracts. Among those whose facilities were adequate, some were chosen and some were not.  

Firms were selected almost at random. Despite the need to institute quantity production as rapidly as possible, some firms that could have produced airframes were ignored. The case of the Singer Sewing Machine Company illustrates the problems some firms faced in their dealings with the War Department. The Singer Company had no experience in aircraft production. It did have one of the largest veneer and cabinet
work plants in the country. This made it valuable as a possible source of production for the wooden aircraft of the time. The officers of the company were not seeking government contracts, but they offered their facilities to the government if needed. Representatives of the Singer Company visited the Curtiss and Dayton-Wright plants to examine aircraft production methods. Originally, Singer was to produce 3,000 training planes, although this was changed to 1,000 DH-4's. Another Singer representative went to Dayton-Wright to examine a sample DH-4. The letter of introduction supplied to the Singer representative on August 15, 1917 revealed that plans were still very tentative.

We are asking the Singer Sewing Machine Company to conduct such investigations as is possible while we are making up our minds as to the part of the program they should fulfill... We suggested that they should help in the DeH-4 production. This is not definitely settled, and they may be given some other part of the program, but we would like them to have the privilege of an opportunity to study the details of the DeH-4, in as much as it represents the latest type... of war machine from abroad.16

When the Singer Company received this letter they decided that the inspection trip would be postponed until a definite decision on their wartime work was made. Colonel Waldon of the Aircraft Board approved the decision, since "we have received a cablegram which indicates that there will be very important changes in our program, in all probability causing us to change the type of machine you would
build." Before any final decision was made, the British government offered Singer a contract to build airplane parts. The American government approved this arrangement. Singer employed approximately 100 people and a small part of its plant capacity on the British order. Despite the fact that the company could have built more aeronautical equipment, it was never again contacted by American authorities.17

From the outset, production was required before operations could begin. As time went on, production experts found that in order to build up an aircraft industry to the production level required the government would be obliged to supply machines and equipment with the signed contracts. The government also had to finance new buildings and machinery, buy land for new factories, to expedite railroad shipments, and to allocate raw materials from the supply that other industries had already depleted. All of these processes required contracts, which in war time meant a change in the normal contracting process.18

In peace time, four factors normally affected the forms of contracts. The most important was cost, then quality, quantity, and time. In war time, the order was reversed. Time became the primary factor. Rapid production was stressed and cost became the least important concern. Within these guidelines, the three most important forms of wartime contracts were competitive awards, cost-plus contracts, and
fixed price contracts. In wartime, in view of the emergency situation, the competitive procedure was waived in favor of other methods of purchasing better adapted to the changed conditions. Using procedures formulated in the National Defense Act of 1916, the cost-plus contract became the favored form for aircraft procurement. In general, the government reimbursed the contractor for all costs of labor, material, plant depreciation, and overhead expenses. The government also guaranteed a fixed profit on aggregate costs and a premium for any reduction of actual cost below the provisional or "bogey" cost per unit.\textsuperscript{19}

The cost-plus basis was used for aircraft contracts on the assumption that the manufacturers had insufficient experience to fix the cost definitely. As estimated or "bogey" cost was made, and a profit was fixed on that. For example, the contract for the DH-4 limited the profit to 12\(\frac{1}{2}\)% or $875 per plane on a bogey cost of $7,000. But the actual cost was approximately $4,000 per unit, and the company got 25% of this saving, which amounted to approximately $2,750 per plane. Therefore, the company made a net profit of $1,525 per unit. When the bogey cost of $7,000 was fixed, letters were obtained from the Dayton-Wright and Fisher Companies stating that after 250 planes had been produced there would be an adjustment if the bogey cost was found to be "materially wrong." Based on this agreement,
new contracts were drawn establishing a bogey cost of $5,000 and setting a fixed profit of $625 per plane.\textsuperscript{20}

The cost-plus contract for the Liberty engine was very similar to those for the DH-4. The initial bogey cost was $6,087 plus a profit of $903.05 (15%). This was later reduced to $5,000 plus a 12\% profit of $625. These contracts also had a clause which provided a bonus for production below the bogey cost. The price was later reduced to $4,000 per unit on a fixed price contract. Any profit came from this sum. Fixed price contracts also contained wage and price adjustment clauses.\textsuperscript{21}

Initially, cost-plus contracts were let for the Liberty, Hispano, Le Rhone, Gnome, and Bugatti engines and the J-1, DH-4, and Bristol aircraft. Fixed price contracts provided the JN series of trainers, elementary training engines, and a small number of J-1 trainers and Hispano engines. The fixed price contracts were used for items that had been produced before the war, meaning that a more clear picture of costs was available.\textsuperscript{22}

It appears that the War Department prejudiced the contractual situation by using planners who knew little or nothing of the requirements of the aircraft industry. There was no member of the advisory boards who knew what a reasonable cost would be. This led to bogey costs that were initially set extremely high, although they were later reduced.
This cost the government millions before the situation was revised.

By late September, 1917, most of the program had been drawn and enabling contracts had been let. Almost immediately, however, problems appeared that blocked the course of quantity production. These problems ranged from design changes to attempts to use the Liberty engine in planes not designed for its power and weight. Despite these problems, the aircraft production and procurement program did achieve some successes during the course of the next twelve to fourteen months.
NOTES

1 Crowell, America's Munitions, p. 266.


3 Rae, Climb to Greatness, pp. 1-2; Dickey, "Liberty Engine," p. ix.

4 Crowell, America's Munitions, p. 265.


6 Ibid., pp. 10-12, 14-17, 19-21; Mixter and Emmons, Aircraft Production Facts, pp. 16-18; MSS "History BAP," VII, p. 1890.


9 Crowell, War Contracts, p. 235; Holley, Ideas and Weapons, pp. 120-121.


11 Table 4 and related material compiled from "Hughes Report," p. 897; Signal Corps and Air Service, pp. 66-72.


13 Ibid., for Tables 5, 6, and related material.

14 Material for Table 7 compiled from "Hughes Report," p. 900.


16 Ibid., pp. 900-901.

17 Ibid.
18 MSS "History BAP," I, p. xii.

19 Crowell, War Contracts, pp. 36, 32-33, 13, 237.

CHAPTER IV
The Failure of the Aeronautical Effort

American industry responded immediately to the wartime demands of the War Department and the Signal Corps, but serious problems in the production system developed because of impractical plans, questionable decisions, and institutional inefficiency. These problems can be traced to the inexperience and ignorance of those who controlled the production program. Planners familiar with the intricacies of aircraft production would have not made the many design changes and variations in the program that marked the actual course of production. Between about September 1, 1917 and February 1, 1918, the results of the hasty, ill-advised, and erroneous decisions made in the early days of the war became painfully obvious. The failings that haunted the program throughout this six month period doomed the overall production and procurement effort.

These failings were obvious to people throughout the country, from War Department planners to private citizens like Gutzon Borglum, a noted sculptor who tried to publicize the collapse of the program. To meet the rising chorus of criticism, government officials relied on public pronouncements that implied the initial problems met in the aircraft
program were gradually being solved. On February 21, 1918, an official release reported that "the first American-built battle planes are today en-route to the front in France. This shipment, though in itself not large, marks the final overcoming of many difficulties met in building up this new and intricate industry." This statement was misleading. The shipment amounted to a single DH-4. The next shipment did not occur for several weeks. The statement was official admission that it had taken almost a year to produce a handful of aircraft.¹

The effects of the unfortunate decisions made in the course of creating a massive aircraft were compounded by the excessively confident tone the administration used to publicize the program. The planners promised too much to Congress and the American people in a burst of unfounded optimism. Some people in the War Department, including Colonel Bolling, were skeptical of what could be accomplished. However, once the need for aircraft had been determined, the American public had to be sold on the idea. Even Newton Baker was aware of the risks this selling job entailed:

I had known for some time that the importation of the advertising methods of American private business into the government would lead to unfortunate disappointments of too florid expectations, but I confess that I do not know how the American mind could have been aroused to the need of great effort in aircraft by any other process.²

There was an element of truth in the release, however.
Many of the problems "met in building up this new and intricate industry" were being met and in some cases solved. By March, 1918, some bureaucratic reorganization had occurred, and more sweeping changes were being planned by President Wilson. The result was the creation of the Division of Military Aeronautics and the Bureau of Aircraft Production in May, 1918. The confusion in the aircraft plants had given way to more stability, especially in design specifications. (Design changes had been made almost weekly throughout late 1917.) Production began to increase gradually in March, with quantity production beginning in late spring, 1918.

The difficulties that plagued the production effort were not confined to any one aspect of the program. Raw materials were in tight supply, although shortages never reached serious levels. Manufacturers were poorly treated by the government. Frequently, blueprints were of poor quality and had to be redrawn. Measurements and specifications had not been converted from their metric base, creating further delays while this was done at the plants. The government procrastinated in awarding firm production orders, so contractors could not plan their material and labor requirements. In some cases, orders that were given were modified or cancelled completely. From a technical standpoint, the frequent changes in design specifications made it very difficult to institute mass production. Even when finished air-
craft and engines were ready for shipment there was a shortage of rail transportation that made their deployment difficult. These problems lessened as those in charge of the program gained experience. Unfortunately, the learning process proved to be expensive and ultimately fatal to the production effort.\(^3\)

The supply of aircraft to the American Air Service in France was determined by two factors, American purchase abroad and domestic production. It is essential to examine America's foreign purchase program because difficulties encountered in this quarter had a profound effect on decisions made in America.

The report of the Bolling Mission advised that America could obtain the aircraft it needed for use at the front up to July 1, 1918 from foreign suppliers:

After long and careful consideration of this subject, we and all the others have come to the very strong conviction that most of the airplanes and engines for American use at the front and for our training here between now /August, 1917/ and July 1, 1918 must be produced either in France or Italy, where effective and successful methods of production are already in full operation. Because we consider this imperative and absolutely essential to prevent failure of our air campaign next year, an arrangement has been made with the French Government under which they are to produce for us . . . airplanes and engines.

A formal contract was made between General Pershing and the French government on August 30, 1917, for the 5,000 service planes and 8,500 engines listed in Table 8. The
United States was to supply the necessary machine tools and raw materials.

**TABLE 8**

American Orders for French Aircraft and Engines

**Service Airplanes**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Type</th>
<th>Projected Deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nov</td>
</tr>
<tr>
<td>1500</td>
<td>Breguet</td>
<td>60</td>
</tr>
<tr>
<td>2000</td>
<td>Spad</td>
<td>-</td>
</tr>
<tr>
<td>1500</td>
<td>New Spad or Nieuport</td>
<td>-</td>
</tr>
</tbody>
</table>

**Service Engines**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Type</th>
<th>Projected Deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nov</td>
</tr>
<tr>
<td>1500</td>
<td>Renault</td>
<td>60</td>
</tr>
<tr>
<td>4000</td>
<td>Hispano</td>
<td>-</td>
</tr>
<tr>
<td>3000</td>
<td>Gnome</td>
<td>-</td>
</tr>
</tbody>
</table>

America was unable to supply the raw materials necessary to produce these planes within the allotted time, due primarily to a shortage of shipping space. The material deliveries were not completed until late 1917. In December, 1917, the original contract was modified. The new contract called for production totals that averaged about seventy-five percent less than the initial orders. By February 1, 1918, 600 planes of all types had been delivered. Approxi-
mately 70 of these were fighters and bombers. On May 3, 1918 all the contracts were cancelled. France agreed to supply as many planes as it could, subject to continuing deliveries of raw materials from America.\textsuperscript{5}

French failure to supply America's initial aviation needs was one cause of the confusion that infected the decision-making agencies in Washington. Nowhere was this more obvious than in the effort to produce a single-seat fighter in late 1917 - early 1918. The original Spad program, as suggested by Bolling, actually involved two types, the Spad with the Hispano-Suiza engine and the Spad Monocoque with the Gnome rotary engine. The Spad Monocoque failed during development in France and was dropped from the American program. On October 5, 1917, American representatives overseas advised that the United States should "build no rotary engine single-seater pursuit airplanes to be sent to Europe; existing machines this type will be outclassed by changing time yours arrives; build only what you need for use in United States training purposes." This recommendation did not involve the Spad with the Hispano-Suiza engine. This plane was in service in France, and Colonel Bolling reported on August 1, 1917 that the Spad was "the best fixed-engine fighter aircraft in service." There was no reason why this plane could not have been produced in the United States. The failure to produce the Spad was not due to lack of facilities but to a
change of official opinion at a critical time in the course of the program. 6

On September 19, 1917, the Aircraft Production Board passed a resolution recommending that contracts be awarded for 3,000 Spads. A single contract for all 3,000 was placed with the Curtiss Corporation on that date. The Spad was redesigned to accommodate the Liberty eight cylinder engine. Soon after this order, the advisability of producing any single-seat fighter was cast in doubt by a cable from American representatives abroad. On October 5, 1917 a cable was received that advised that "no monoplace pursuit planes" be built, and that resources allocated for their production be diverted to the DH-4 program. The cable also questioned the ability of the Liberty-8 to provide enough power for a single-place aircraft. On October 27, 1917, Lieutenant Colonel V. M. Clark of the technical staff of the Bolling Mission told Howard E. Coffin that "all fighting and bombing by day will be done in two-seaters flying in regular formation. The single seater will be eliminated." Preparations for production of the Spad were well underway, but the order with the Curtiss Corp. was cancelled on November 7, 1917. 7

Another cable was received on November 8, 1917 that echoed the feeling that single-seaters would soon become obsolete, although the cable recommended that "you produce number already under contract and started." Further word from
Europe, received on December 14, 1917, suggested that "the United States should leave the production of single place fighters to Europe." Any fighters needed by Americans, including the Spad, could be obtained from French sources. Based on this information, preparations for the production of single-seat fighters in America were completely abandoned. The Curtiss Spad order was replaced by one for 2,000 two-place Bristol Fighters.\(^8\)

Less than two months later, American representatives abroad demanded that Spad production be restarted as quickly as possible. A cable on February 10, 1918 recommended producing 1,000 Spads in order to make up the shortage that resulted because the French were unable to produce the planes as ordered. The Aircraft Board replied that this new recommendation did not fit into current American plans. On April 19, 1918, a cable from abroad advised that the United States should make immediate preparations for the production of single-seat machines to supplement those that might be received from France and England. This resulted in a recommendation by the Joint Army and Navy Technical Aircraft Board on April 22, 1918 that the British SE-5 be manufactured in the United States. American experts in Europe replied on May 4 that they disapproved of America making the SE-5, since it could be obtained in Europe. On May 15, Washington planners,
aware of the conflict in recommendations and the apparent reversal of policies, announced that they were not going to cancel the SE-5 program.9

On June 6, 1918, an order for 1,000 SE-5's was placed with the Curtiss Corp., which had since lost the Bristol contract. Fifty-four were also ordered in England. Later, 999 of the 1,000 were cancelled, and only one SE-5 was manufactured in America by November 11, 1918.10

Because of official indecision, the United States did not produce a single-seat fighter for service in Europe. It is obvious that blame must be shared by American agents in Europe and by the Washington establishment. However, the Aircraft Board was unwilling or unable to make a decision it could stand behind in the face of contradictory information arriving from Europe. The Spad was dropped because it did not perform well with the Liberty-8, and comments from Europe supported this decision. The SE-5 was chosen because it appeared to be a design that could be adapted to the Liberty. The Curtiss Corp., the largest producer of aircraft in America, remained idle while policy planners struggled to find out what was needed. By the time a decision was made, seven months had been lost. In the end, even the "final" decision to build the SE-5 was overturned. The inexperience and incompetence of the bureaucracy was to blame for the failure of this phase of the program.
The decision to fit the Liberty into an airframe not
designed for it doomed another part of the program. In the
autumn of 1917 the Aircraft Board decided that the Spad, Bris-
tol, and DeHaviland types would be redesigned to carry the
Liberty engine. The Bristol program failed because the air-
frame could not handle the Liberty engine. The initial rede-
sign effort was based on the premise that the Bristol’s wing
loading would not be increased beyond the design limit of 7.1
pounds. Colonel V. M. Clark made several design changes but
kept the wing loading within the prescribed limits. Later
changes made by the Signal Corps and production engineers
increased the wing loading to 9.2 pounds. Some of these mod-
ifications were the result of increased strain imposed by the
heavier and more powerful engine. During the redesign phase,
a contract for 2,000 of the Liberty-engined Bristol’s was
signed with the Curtiss Corporation. After a series of tests
in July, 1918, where several pilots were killed, the contract
was cancelled. Only 27 planes had been delivered, although
hundreds more were nearing completion. $6,5000,000 was
spent on the design before work was stopped. In converting
the Bristol to use the Liberty engine, aviation planners had
gambled in the hope of securing an aircraft of superior per-
formance rather than turning out exact copies of the Bristol
design in large numbers. The gamble failed.11
The one- and two-seat fighter programs failed. The heavy bomber program was the next to suffer the same fate. Although the Handley-Page and Caproni planes remained on the program, production was delayed. Early in the summer of 1917 the Aircraft Production Board requested that the Standard Aircraft Company hold its Elizabeth, New Jersey plant in readiness to build Caproni planes. On September 15, 1917, the Signal Corps made a verbal contract with the Curtiss Corporation to build 500 Caproni planes. Curtiss produced no planes on this order because the Signal Corps failed to provide the required blueprints. Curtiss and the Signal Corps agreed to cancel the Caproni contract and substitute one for the Bristol Fighters.12

In January, 1918, the Signal Corps ordered 1,000 Caproni's from Standard Aircraft, approximately seven months after the company was warned to expect an order. Fifty of the Caproni's were to be assembled for flight testing in America. The remaining 950 were to be shipped overseas unassembled. The company prepared production drawings, but no official contract was forthcoming. On January 25, 1918, Captain D'Annunzio and nineteen mechanics from the Caproni plant in Italy arrived in New Jersey, and work began on a hand-made machine. However, in February the airplane authorities began to question whether the Caproni should be built in quantity. By March 2, 1918, the Aircraft Board recommended that the
Caproni program be dropped. This decision was made when it became apparent that the machine could not easily be modified to accept the Liberty engine. The Handley-Page 0/400 was chosen as a substitute. Captain D'Annunzio pressured Colonel Deeds to reconsider, and he was allowed to build a complete experimental machine. That plane was flown on July 7, 1918. On April 12, the Fisher Body Company received an oral contract for 250 Caproni's, which was later cancelled by the Signal Corps. On May 18, both Curtiss and Fisher Body Company were given contracts for 500 Caproni's. The program was officially restarted, but the Bureau of Aircraft Production delayed production until testing was completed. By November, 1918, no Caproni's had been built.\textsuperscript{13}

Plans for the Handley-Page 0/400 were supplied to the Signal Corps in the summer of 1917. In February, 1918, contracts were let for 1,000 machines with several firms. The order was subsequently reduced to 500 planes. These were to be shipped in pieces, to be assembled in England. By November, 1918, seven Handley-Page aircraft had been assembled in the United States. The parts for 303 more were available for shipment. One hundred sets of parts, with 52 engines, were in England or in transit.\textsuperscript{14}

Plans called for America to produce all of her own training planes. Aircraft of this type were produced in America before the war, so this phase of the program was the
most successful. The choice for primary training planes was the Curtiss JN-4D with a Curtiss OX-5 engine. Contracts for 5,000 of these were made during the war. Of these, orders for approximately 1,500 were cancelled and 3,500 were produced. The Curtiss JN-4D proved satisfactory for the job for which it was intended - primary training.\textsuperscript{15}

It soon developed that the manufacturers could not produce the JN-4d's as rapidly as the schools needed them. Therefore, the Standard Aero Company's design, the J-1, was selected for production, equipped with the Hall-Scott A-7a engine. It is important to note that the Joint Army and Navy Technical Aircraft Board recommended that the Standard J-1 be equipped with the Hispano-Suiza engine. The Aircraft Production Board elected to produce the J-1A-7a combination. Sixteen hundred of this type were ordered and delivered between August, 1917 and May, 1918. Because of problems with the Hall-Scott engine the Standard J-1 became too dangerous for service and on June 6, 1918 the Director of Military Aeronautics ordered that no further flights be made in the plane. Curtiss JN-4's, which were more plentiful at the time, were substituted. The Standard J-1 program cost the govern-ment about $6,000,000 before it was cancelled. It is inter-esting to note that the J-1 program was a complete success, although the plane itself proved a failure.\textsuperscript{16}
The first service plane to be put into production and the only American-built plane to see action in the First World War was the DeHaviland-4. The first sample DH-4 arrived in Washington in July, 1917. It was redesigned to accept the Liberty engine, new instruments, and other auxiliary equipment. Design of the machine gun mounts was altered five times. Each of these changes affected many other parts of the plane. All these changes created delay, and the delay was exacerbated by continuing indecision as to whether this type should be produced at all. The Bolling report had in fact recommended that the DH-9, an improved version of the DH-4 be produced. However, after considerable discussion and awarding and cancelling of orders for both types, actual manufacture of the DH-9 was postponed. On November 14, 1917 production of the DH-4 as an observation and bombing plane was begun.\(^{17}\)

The contracts for the DH-4 called for 8,500 planes. Dayton-Wright was to produce 4,000, Fisher Body 4,000 and Standard Aircraft 500. The first DH-4 left the Dayton-Wright plant on February 5, 1918. The plane was shipped to Europe on March 22, arriving in Europe on May 4, after its transport developed engine trouble in the Azores. This is the plane referred to in the dispatch discussed earlier. There were no shipments for the American Expeditionary Forces between February 5 and April 3, 1918. The thirteen
produced during this period were retained in America for tests. Shipments to Europe were resumed in April, when twelve were shipped. In May, 1918, quantity production began. By the end of May, 193 planes had been delivered by Dayton-Wright. This was increased to 326 in June. Of the 545 produced to that point, 381 had gone to ports of embarkation. Deliveries increased monthly until November, when approximately 1,100 were produced by all three contractors.  

A total of 1,213 American-built DH-4's were delivered to the A.E.F. in France by November 11, 1918. By that date, 628 had reached rear area supply depots, 499 of these were delivered to squadrons, and 417 had been used in action on the front. Thirty-three Dh-4's were lost to enemy action during the war.  

Two types of training planes, one of which was condemned, and one service plane were the effective sum of American industry's airframe effort. The picture is slightly better when one examines the engine production program. Total engine production totalled approximately 30,000 or about one-third of the amount contracted for. The 14,000 Liberty engines, most of the twelve cylinder models, accounted for almost half of the total engine production. Since American factories were more used to the production of engines, they fared reasonably well throughout the war. The factories were not beset by the same confusion and indecision that delayed air-
frame production, primarily because relatively few types were chosen for production, and because the Liberty played such a major role in the overall effort. Aircraft were dropped because they could not use the Liberty, but the engine remained in production without stop.\textsuperscript{20}

Between April 6, 1917 and December 31, 1918, the United States produced approximately 30,000 engines and 12,500 aircraft. Contracts called for about 101,000 engines and 23,000 aircraft. When the war ended, remaining obligations on these contracts were cancelled. Congress had appropriated $1,047,107,458.83 for military aeronautics for fiscal years 1917-1919. Actual expenditures by the time the war ended totaled $868,100,671.17. After adjustments are made for the cancellation of contracts, sale of surplus materials and sales to foreign governments, the net cost of wartime aviation was $608,865,307.50.\textsuperscript{21}

These figures are meaningless until one compares them to European data for the same period. Certainly the United States produced only a fraction of what it wanted to produce during the war. However, by the time the war ended, American production had reached very substantial levels. In January, 1918, approximately 750 planes were produced, a rate of 9,000 planes a year. In the same month, Italy produced 305 planes (3,660/year), France 1,484 (17,800/year), and England 2,347 (28,000/year). By September, American production had
### TABLE 9
American Aeronautical Production During the First World War,
April 6, 1917 to December 31, 1918

#### Aeronautical Engines

<table>
<thead>
<tr>
<th>Type</th>
<th>Contracts</th>
<th>Actual Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>OX-5</td>
<td>9,450</td>
<td>8,318</td>
</tr>
<tr>
<td>A-7a</td>
<td>2,250</td>
<td>2,250</td>
</tr>
<tr>
<td>Gnome</td>
<td>342</td>
<td>280</td>
</tr>
<tr>
<td>Le Rhone</td>
<td>3,900</td>
<td>1,057</td>
</tr>
<tr>
<td>Lawrence</td>
<td>451</td>
<td>450</td>
</tr>
<tr>
<td>Hispano-Suiza</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 HP</td>
<td>4,500</td>
<td>3,435</td>
</tr>
<tr>
<td>180 HP</td>
<td>4,000</td>
<td>469</td>
</tr>
<tr>
<td>300 HP</td>
<td>10,000</td>
<td>8</td>
</tr>
<tr>
<td>Bugatti</td>
<td>2,000</td>
<td>8</td>
</tr>
<tr>
<td>US-12</td>
<td>56,100</td>
<td>13,574</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100,993</strong></td>
<td><strong>29,849</strong></td>
</tr>
</tbody>
</table>

#### Aircraft

**Primary Training**

| SJ-1            | 1,600     | 1,600 (condemned, July, 1918) |
| JN-4D           | 4,800     | 3,587             |
| Penguin         | 6,450     | 5,237             |

**Advanced Training**

| JN-4 & 6H       | 1,400     | 1,432             |
| S4-B & C        | 500       | 398               |
| E-1             | 12        | 12                |
| SE-5            | N/A       | 2                 |
| **Total**       | **(1912)**| **1,844**         |

**Service**

| DH-4            | 8,500     | 4,587             |
| Spad            | 3,000     | 0                 |
| Bristol         | 2,000     | 0                 |
| Handley-Page    | 500       | 107               |
| Caproni         | 1,000     | 1                 |
| **Total**       | **15,000**| **4,719**         |

Total Aircraft Production: 12,571²²
reached 1,207 planes, and by November, American factories were producing planes at a rate of 23,000 planes a year. Unfortunately, much of this production came too late to be of much use to the war effort. Only 417 DH-4's had actually seen action on the Western Front when the fighting stopped.  

It took more than a year to get production started in the United States, and approximately fifteen months to begin quantity production. The war ended at a time when the situation in all phases of the aircraft production and procurement program had improved considerably. The coming of the Division of Military Aeronautics and the Bureau of Aircraft Production in June, 1918 brought more expert and rational control to the program. American designers began to work on planes that were designed specifically to take advantage of the Liberty engine. One, the Le Pere, showed promise of becoming a truly great fighter. Then the war ended. The relief felt at the end of the fighting gave way to a sense of disappointment because so little had been accomplished. Grover C. Loening, an aircraft designer, expressed the feelings of many when he wrote:

Then, it seemed to me very suddenly, the Armistice was signed. And in a daze I realized that this great opportunity was gone forever. I should not say that I was bitterly disappointed, because we all wanted the war to end, but the truth of the matter is that it was a terrible blow.  

The end of the war brought an end to governmental support of aviation development for several years, although
the neglect never again sank to pre-war levels. The existence of substantial stocks of airframes and engines retarded the development of newer types throughout the 1920's and 1930's. Many firms that had been formed to build planes during the war were forced to close soon after its end. By the mid-1920's many of the lessons learned from the wartime experience appeared to have been forgotten.

The collapse of the aircraft production effort in late 1917 and early 1918 was the unavoidable result of the ignorance and incompetence of the production planners in the years before the war. The planes and engines that were produced were made despite the conditions in the program. The production of this relatively small number of planes and engines demonstrates the extent to which the producers were able to overcome the obstacles unwittingly placed in their path by the bureaucratic bungling of the so-called experts in Washington.
NOTES


3 Crowell, War Contracts, pp. 246-250.


5 Table 8 and related material drawn from "Hughes Report," pp. 895-896.

6 Ibid., p. 897.


9 Signal Corps and Air Service, p. 80.

10 Ibid.


13 Ibid.

14 Ibid., pp. 3853-3854; Signal Corps and Air Service, pp. 83-84.

15 Signal Corps and Air Service, p. 67.


17 Signal Corps and Air Service, p. 78.


19 Correll, The Measure of America's World War Aeronautical Effort, pp. 43, 46.

21 Gorrell, The Measure of America's World War Aeronautical Effort, pp. 8-10.

22 Material for Table 9 compiled from Mixter and Emmons, Aircraft Production Facts; Gorrell, The Measure of America's World War Aeronautical Effort; MSS "History BAP;" and "Hughes Report." The figures given should be considered accurate for most types, except for the Liberty and the OX-5 engines, where the range would be +/- 5%. This is because none of the sources list exactly the same figures. Gorrell's figures appear to be the most accurate, since they were based on the most complete research approximately thirty years after the war. The total aircraft production figures do not include a variety of types that were produced as purely experimental models and not given an official slot in the program. Some sources include these odd models in the overall figures. The possible margin of error of these figures does not affect the conclusions of this work.

23 Gorrell, The Measure of America's World War Aeronautical Effort, p. 34.

24 Freudenthal, Aviation Business, pp. 55-56.
CHAPTER V

Conclusion

The failure of the World War I aviation effort was the unfortunate and unavoidable result of the inexperience and incompetence that pervaded all elements of the aircraft program. These conditions were exacerbated by the feelings of unjustified optimism and a misplaced belief in the ability of American industry to produce miracles on call, selected instances of personal malfeasance at the highest levels of the planning bodies, and an epidemic of bureaucratic bungling and "buck passing" throughout the effort. Winston Churchill once said that in the field of military procurement, production would follow a set pattern: "The first year, nothing; the second year, a trickle; the third year, all you want." American aircraft production during the First World War fit nicely into this pattern, to the intense discomfort of all involved in the program.

Some commentators have tried to dismiss the systemic causes of the failure of the program by claiming that critics had neglected a very important fact when they considered the course of production. American industry was aiming to reach its full potential in 1919, when the final offensive to knock
Germany out of the war would begin. Therefore, it was unfair to say that American industry had failed. The war ended before all of America's industrial might could be brought to bear. This is true. The war ended more quickly than most people had dared hope. However, this "long war" hypothesis neglects to explain why some phases of the industrial effort, especially those parts connected with the aircraft production program, were so slow in achieving any kind of output. The United States did make a considerable contribution to the Allied war effort, even when one includes the aircraft program. An important question remains. Why was America unable to attain the goals it had set for itself in the spring of 1917?¹

Reasons for the failure of the program can be examined on several levels. The Wilson administration, the War Department, and the civilian bureaucracy must all bear some of the blame. The official incompetence was such that the industrial sector could rightly claim that it bore almost no responsibility for the ultimate failure. There was little industry could do. The multitude of possible explanations for the collapse of the program demonstrates how absolute the failure was. However, all of these problems can be traced to the lack of aviation experience that grew out of pre-war neglect of the development of the aircraft and its attendant
industry. Lack of experience explains the clumsy bureaucracy, the confused programs, and the faulty decisions that doomed the program. Without any previous experience to guide them, the unfortunate bureaucrats were forced to make decisions involving hundreds of millions of dollars, vast quantities of raw materials, and the livelihood and lives of thousands of workers and fliers. Almost every one of the decisions made by these newly hatched experts proved to be the least viable of a number of options. Because of these damaging decisions, the program failed.

The bad decisions followed a pattern throughout the war. An initial decision, perhaps regarding aircraft types or numbers, was made in haste. Contracts were let based on this initial decision. Then doubts set in. Planners hesitated, unsure that they had done the right thing. Frequently orders went out halting or delaying production. At this point changes would be made in the original order, calling for more planes, or a bigger engine, or a new contractor. Any work then in progress at the aircraft plants would stop while these changes were made. A program would go through perhaps a half dozen of these changes in the space of perhaps three months. If by this point the bureaucrats had decided that the aircraft or engine in question was to remain on the program, production would begin. In some cases,
however, a design was dropped, and the process would begin again. If production was allowed to continue, the results of the initial decisions would appear, sometimes dooming a program that otherwise appeared to have been successful. In most cases, problems at this phase revolved around improper engine and airframe combinations. The J-1/A-7a and Bristol/Liberty projects are the best examples of this. Both projects seemed reasonable at the planning stage, but actual flight tests showed that the J-1 lacked the power to get safely off the ground. The Bristol had too much power and was too heavy to land safely. Faced with problems such as these, the ultimate failure of the program is not surprising.

The initial decisions were made by planners at the highest levels of government. The American air force was in very bad shape at the start of the war. No branch of the Air Service, from pilots to planners to mechanics, was ready to meet the demands of a war. However, the use of airplanes on the front had captured the imagination of many. When America entered the war, it decided to create a massive aircraft program. With virtually no experience in the field of aircraft production, planners approved a massive expenditure of time, money, and effort to create an air force out of nothing. When this decision was made, planners from Secretary of War Baker down did not comprehend the seriousness, difficulty, or cost of the projected undertaking. Lacking
information to the contrary, the planners felt that the program could be completed with great effort but few major problems. The task the Army air arm set for itself, at the insistent urging of the Allies, proved to be beyond the capabilities of American industry. A decade of neglect had to be overcome almost overnight. The resources available were not a broad enough base on which to build the enormous structure required. The experience of 1917 and 1918 was a lesson in the time it takes to determine types, create designs, provide facilities, and finally produce planes.

The decision to try to build 20,000 airplanes and 40,000 engines in eighteen months was wrong. The folly of the decision should have been obvious to many people throughout the administration. It was not. The program was not based on any rational, unemotional examination of the capabilities of American industry. The production plans called for too much too quickly. The program was not based on any specific plan of deployment or development. In 1916 and 1917, America struck wildly. The important thing was numbers, of troops, of shells, and of planes. The need for the troops and shells was obvious. American generals knew what to do with them. No one really knew what to do with the aircraft. By late 1918, this situation had improved. Tactical doctrines had evolved. But at crucial stages of the program, when strong
guidance and a sense of direction were needed, the system established by the War Department was found lacking.

Blame for this pitiful situation is difficult to place. Woodrow Wilson agreed to a program he knew nothing about. He signed the appropriations bill that gave the Signal Corps the money it needed to fund the program. Wilson acted on the recommendations of his advisers. In the summer of 1916 he had so much to do that it is unreasonable to expect that he could have taken the time to reexamine variables that his advisers had supposedly considered.

The chief of Wilson's advisers on military affairs was his Secretary of War Newton D. Baker. If any one man can be blamed for the sorry situation in the aircraft program in late 1917, it is Baker. Baker had available to him the tools necessary to make decisions about the practicality of the program. He had the power, both military as Secretary of War and civilian as chairman of the Council of National Defense, to exercise strong control over the planning and production processes. His major fault was that he refused to use his power to create the strong centralized system that could have effectively evaluated the variety of information that was flowing into the War Department planning bodies. Instead, the Aircraft Production Board, the Council of National Defense, the Joint Army and Navy Technical Aircraft Board, and the National Advisory Committee for Aeronautics all worked
independently, each with its own idea of what should be done. Each submitted recommendations, and no one person or body was in a position to evaluate the merits of a proposal, shape it into a program, and then follow the proposal through to a conclusion. Frequently, each proposal became a program in its own right, as the variations in the DH-4 program demonstrates. There was no strong leadership at the upper levels to shape and guide the program.

Many in the War Department and elsewhere expected the Signal Corps to provide the leadership needed. Unfortunately, the Signal Corps was no better prepared than any other body to assume control of the aircraft program. Brigadier General Squier was a fine Chief Signal Officer, but he knew nothing about aviation and was dependent on others for advice. Frequently, this advice was poor. Often, Squier was forced to rely on the advice of men who had little knowledge of the methods of the Signal Corps or the Air Service. The rise of Colonel Deeds was the result of the patronage of Secretary Baker and Howard E. Coffin, not General Squier. Many have tried to paint Squier as the real villain in the procurement controversy. This is unfair to Squier. His department and his reputation were victimized by the misdeeds of others. ²

The work of the industrial representatives called to government service during the war is difficult to evaluate.
They made decisions which actually led to the failure of the program. They decided to build the Liberty and fit it into the Spad, the DH-4, the Bristol, and the heavy bombers. Their proposals were used by the Signal Corps as the basis for its programs. When the Signal Corps chose a firm as a contractor, it had every reason to believe that the firm could do what was expected of it. No one realized how difficult it was to produce aircraft. Even today, most of their decisions seem quite reasonable. The automakers had built engines before, so why not the Liberty? It seemed like a valuable project. But because of these decisions, the program failed. The options open to Deeds and Waldon were quite limited. Since America was committed to a large aircraft program, the Signal Corps had to turn to those firms that were experienced in large scale production. Their choices were few.

An evaluation of the position of these ad hoc experts is made more difficult by the career of Colonel Deeds. His alleged misdeeds cast a pall of suspicion over the work of many others. Many of Deeds' actions were of questionable legality and unwise for a man in his position. They were apparently within the law, however. It became fashionable to blame the failure of the program on Deeds. Many of his decisions were responsible for the later collapse of the program, but they were made in good faith. Again, his options
were limited. The system he worked in was inefficient, and this inefficiency compounded his own failings. The system was not of his own creation, however, and Deeds cannot bear total responsibility for its collapse.

The most important influence of the industrial representatives who went to work for the government was that they prevented others from assisting in the war effort. They tended to make decisions that reflected their own field of expertise and their own industrial biases. Deeds and his compatriots had to make the detailed decisions throughout the war. They determined numbers and types to be produced. Aviation experts in name only, they vacillated and hedged for months while the program slipped further behind schedule. Their lack of knowledge and experience was so complete that they had to rely on the advice of French Premier Ribot, who knew absolutely nothing about the state of affairs in American industry, as the source of their estimates of the size program they created. The Ribot plan was beyond the capacity of American industry as it existed in 1917. Neither Ribot nor many Americans realized this. This episode demonstrated that there could be no substitute for native experts and experiences in formulating programs.

Unfortunately, there was a systematic attempt to exclude American aviation pioneers from the planning councils.
The auto representatives saw no reason to give up their positions since they felt that there was no body of aeronautical experience available to provide better information than they could. There was a group of aviation pioneers whose advice could have been most useful in examining the industrial problems to be faced in building aircraft. Glenn Curtiss, Grover Loening, and others were available. They offered their services to the government, but were refused. Again the role of Baker was crucial. He allowed Deeds and his associates to keep these true aviation experts out of positions of power. Baker could have appointed Loening or any of a number of other experts to serve on the Council of National Defense or the Aircraft Production Board. He did not.

The inadequacies of the bureaucratic system established to devise and control the program played a major role in its failure. The result of the poor organization of the Aviation Section of the Signal Corps led to duplication of effort and overlapping responsibilities. There were too many advisory bodies and no final arbiter of questions about the program except for the bewildered officers of the Signal Corps, who claimed to have no knowledge of the demands of military aviation. No one was willing to stand strongly behind the decisions these bodies made.

The organizational problems that existed at the highest levels of the program were reflected in the factories.
The aircraft industry was new and there was a shortage of engineers and skilled workmen. Novel problems were encountered at every step and lack of knowledge bred indi
cision and confusion. Experience in other manufacturing enter-
prises gave no assurance of success in this new field, as the
problems faced by the auto manufacturers so clearly demon-
strates. New sources of supply had to be developed, and
problems encountered at all levels of this program were re-
lected in the manufacturer's plants.

After months of confusion and disorder in Washington
and in the aircraft plants, Secretary Baker took steps to
correct some of the more glaring deficiencies in the pro-
gram. With the coming of the Bureau of Aircraft Production,
Deeds and his colleagues were replaced by other businessmen,
no more expert in the affairs of the aviation industry, but
without the taint of criminality that had haunted Deeds.
This change helped the program immensely. Morale improved
in Washington and in the plants. Production increased, and
the programs were stabilized. For better or for worse, the
American effort concentrated on a few types and tried to pro-
duce them in quantity.

Solutions to the problems encountered in producing
aircraft existed at the time, but they went unnoticed and
were ignored. Using the recommendations of Colonel Bolling,
America could have begun a gradual build-up of its aviation capacity by building proven European types. Concurrently, the development of the Liberty and American planes designed around it could have been started. Gradually, plants producing the European designs could have been converted to work on the American types. By stressing concurrent and not exclusive development, America could possibly have made a more substantial contribution to the aeronautical effort. It certainly could have done no worse.

The best course for America would have been either a smaller program, perhaps based only on single-seat fighters, or a large program which stressed exact duplicates of European types. This option would have eliminated the fiasco caused by trying to fit the Liberty into existing airframes. Neither course was chosen because both implied a weakness. The former meant admitting that the United States was unable to produce as many planes as it claimed. The latter required that the development of native American designs be relegated to a secondary role while American factories produced foreign designs. No American planner was willing to approve either approach, although the latter step was recommended by Colonel Bolling. The United States could not recognize and refused to accept its own weakness in the field of aeronautics.

Fortunately, the failure of the aircraft production and procurement effort had some lasting beneficial effects
on the development of military aviation in the United States. The experience of war created a large pool of skilled designers and mechanics who found employment in the small aircraft industry that remained viable after the war. Men like Deeds and Waldon used the financial and managerial information gained during their stay in Washington to gain financial control over large segments of the aircraft industry. Lack of contracts in the early 1920's gave them little opportunity to use their new talents, but in later years they assumed positions of importance in the industry.

Another result of the World War I experience was the slow movement toward a separate, independent air force. It took about thirty years for this trend to reach fruition. In the interim, the development and procurement processes were gradually concentrated in the hands of men who had more complete knowledge of the needs of military aviation. The American air services had the apparatus to procure planes and select the best designs. At times, this process broke down, but its existence was a major step beyond the incompetence of the Signal Corps.

One further result of the initial wartime experience continues to be a factor today. During the war, aircraft manufacturers began the practice of maintaining representatives at military aviation centers to keep in touch with the developing needs of military aeronautics. By the end of
the war, the War Department had established a method for selecting superior weapons and a close working relationship with the manufacturers supplying them. This marked the early development of what later became known as the military-industrial complex. The close cooperation between the military and its suppliers did not gain its sinister reputation for another forty years. Because of the development and contractual systems at the time, it was a very reasonable system of contact that undoubtedly aided the development of new aircraft types.

The political, bureaucratic, and industrial situation at the time made it virtually impossible for the United States to produce the quantities of aircraft it hoped to during the First World War. The production program, over-optimistic from the outset, floundered in incompetence, bureaucratic bungling, and personal ambition. Luckily, the errors committed in 1917 and 1918 were recognized, examined and corrected. When a similar situation arose in 1941, the United States was much better prepared to meet the aeronautical challenges of a second world conflict.
NOTES

1 Proponents of the "long war" hypothesis include, not surprisingly, many of the figures most intimately connected with the aircraft effort. See Benedict Crowell, America's Munitions; Edgar Gorrell, The Measure of America's World War Aeronautical Effort; Issac F. Marcosson, Colonel Deeds, Industrial Builder; and Mixter and Emmons, Aircraft Production Facts.

2 Among the authors who have attacked Squier most strongly are Elsbeth E. Freudenthal, The Aviation Business From Kitty Hawk to Wall Street; and J. Franklin Crowell, Government War Contracts. If Squier can be blamed for anything, it would be his unwillingness or inability to control or influence the planning bodies under his control. It would be an error of omission more than anything else. Certainly his culpability is not as great as Baker or Deeds.
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